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INDEX

PERSONAL INDEX

PAGE

Abbot, C. G. 6, 237, 258
Absalom, H. W. L. 5, 270
Agostinho, J. 195
Albrecht & Co. 198
Alexander, P. Y. 211
Amundsen, R. 150, 160
Andrews, W. 70
Andrews, W. L. 70
Angenheister, G. 46
Ångström, A. J. 205
Antevs, E. 109
Applegate, T. H. 88, 194
Appleton, E. V. 210
Arnold, E., & Co. 197
Austin, E. E. 81, 211
Azzi, G. 269

Babcock, H. D. 66
Baldwin, H. I. 267
Bamford, A. J. 163
Barkow, E. 149
Barlow, E. W. 33, 262
Barnard, F. L. 159
Barnett, H. W. 200
Batty, R. P. 196
Baxendall, J. 137
Bayard, F. C. 19
Beaufort, F. 134
Becker, L. 110
Bemmelen, W. van 6, 81, 86
Bénard, H. 2, 59
Benn, E., Ltd. 119
Bergeron, T. 6, 33, 207
Besson, L. 196
Bezold, W. H. 129
Bickham, S. H. 10
Bilham, E. G. 75
Binney, G. 187
Binns, M. W. 12
Bjerknes, J. 6, 57, 161, 207, 256
Bjerknes, V. 42, 112, 129, 207, 233
Black, W. R. 212
Bliss, E. W. 211, 259
Blodget, L. 277
Boerema, J. 198, 293
Bommer, J. 122
Bonacina, L. C. W. 8, 37, 168, 258
Bond, W. N. 197

PAGE

Booth, R. S. 91
Borns, H. 211
Bower, S. M. 262
Bowie, E. H. 171
Boys, H. A. 19, 192
Braak, C. 45, 294
Brancker, Sir S. 242
Brennecke, W. 234
Bright, J. 270
Britton, C. E. 240, 281, 290
Brodie, F. J. 200, 245
Brooke, Smith L. A. 221
Brooks, C. E. P. 29, 105, 110, 111, 112, 119, 215
Brooks, C. F. 97
Brounoff, P. I. 269
Brown, C. A. C. 212
Brunt, D. 1, 23, 60, 198, 209, 239, 253
Buchan, A. 7
Buisson, H. 137
Bulman, P. W. S. 158
Bureau, R. 266
Burlingham, S. S. 141
Butler, E. J. 212

Calwagen, E. G. 175
Cannegieter, H. G. 243
Canney, E. E. 70
Carpenter, A. 98
Carroll, H. 211
Carter, H. E. 247
Casella, C. F., & Co., Ltd. 71, 294
Casson, R. 211
Castens, G. 221
Cave, C. J. P. 6, 34, 58, 85, 137, 210 259, 282
Cave, Mrs. 210
Chapman, S. 34, 254
Chapman & Hall 22, 97
Chillman, W. R. C. 247
Chree, C. 18, 87, 110, 120, 240
Cierva, J. de la 279
Clapham, D. 122
Clark, J. E. 137, 166, 241
Clark, W. S. 247, 270
Clarke, G. A. 262
Claxton, J. J. 11

PAGE

Clayton, H. H. 237, 282
Clinch, E. L. 70
Clough, H. W 112
Coblentz, W. W. 286
Corless, R. 110
Cornish, V. 210
Cortie, A. L. 121
Cour, D. la 82
Covecque, M. 266
Cowper, J. E. 223, 286
Craigie, — 171
Crawford, O. G. S. 210
Crombrugge, R. von 242
Crosthwaite, J. F. 20
Crosthwaite, P. 20
Cruz-Condé, J. 99
Cumming, A. 72

Dansey, R. P. 10, 40, 63, 140, 142
Danylevski, I. 46
Dassanayake, D. T. E. 163
Dauzère, C. 60
Defant, A. 133, 211, 239
Denning, W. F. 145, 190
Desborough, Lord 14
Deslandres, H. A. 60
Desoil, M. 243
Dexter, A. J. 38
Dines, J. S. 6, 84, 111
Dines, L. H. G. 43, 58, 81
Dines, W. H. 6, 58, 59, 132
Dixon, C. W. 116
Dobson, G. M. B. 17, 137, 211, 257
Dobson, H. J. E. 162
Doodson, A. T. 209
Dorlodot, A. de 243
Douglas, C. K. M. 59, 117, 118
Douglas-Lane G. L. H. 70
Douglass, A. E. .....
Dover, J. 92, 213
Durward, J. 70, 211, 219, 257
Dyer, J. M. 75
Dyke-Marsh, H. St. G. 70
Dyson, Sir F. 209

Ellery, W. 247
Ellis, F. N. 271
Emden, R. 130
Enriquez, C. M. 166
Entwistle, F. 159, 243
Epworth Press, Ltd. 74
Everdingen, E. van 6, 81, 86
Exner, F. M. 6, 129, 207, 223
Eynac, L. 242

Fabry, C. 137, 240, 281

PAGE

Fahmy, H. 58
Farquharson, J. S. 211
Farington, H. N. 9
Ficker, H. 132
Field, J. 84
Filchner, W. 149
Fisher, R. A. 211
Fitzroy, R. 245
Flammarion, C. 122
Flettner, A. 42
Fontseré, E. 82
Ford, C. D. 94
Fowler, J. S. 116
Frankenheim, M. L. 2
Friedmann, A. 199, 247
Frith, E. 74
Fujiwhara, S. 84, 131

Gamba, P. 81
Gams, H. 119
Garbett, L. G. 82
Gaster, F. 245
Geake, E. H. 175
Geer, G. de 119
Gherzi, R. P. E. 5
Giblett, M. A. 32, 210
Gibson, J. G. 2
Gillon, W. 70
Glaisher, J. 86
Glasspoole, J. 69, 75, 115, 143, 199
Gold, E. 83, 130, 136, 243, 271
Goldie, A. H. R. 6, 33, 59, 113, 242
Graham, — 173
Greaves, W. M. H. 210
Gregg, W. R. 243
Gregory, Sir R. 107, 114, 140, 145
Grosse, W. 271
Gudris, N. 94
Guilbert, G. 5
Guldberg, A. 131
Gutenberg, B. 282

Hall, R. W. 10
Hall, W. 211
Hands, A. L. C. 147
Hankin, E. H. 216
Hann, J. 144
Harcourt, Brace & Co. 97
Harding, C. 114
Harmer, F. W. 112
Harries, H. 16, 217, 245
Harrison, D. N. 137
Havelock, T. H. 211
Hay, G. R. 5, 70
Helland-Hansen, B. 233
Helmholtz, H. von 130, 207
Hemming, H. 158

PAGE

Henry, A. J. 277
Hepworth, M. W. C. 221
Hergesell, H. 81, 86, 130
Herschell, Sir J. 167
Herschell, Sir W. 21
Hesselberg, Th. 34, 81, 86, 130
Hildebrandsson, H. H. .. 174, 175, 205
Hinkler, B. 159
Hoare, Sir S. 242
Hobbs, W. H. 150, 209, 271
Hookham, A. H. 141
Hope, J. U. 122
Hoskins, S. E. 164
Houston, Sir A. 14
Howard, A. 74
Howard, E. 72
Howard, L. 72
Howe, G. W. O. 171
Hoxmark, G. 237
Humphreys, W. J. 67, 130
Huntington, E. 109

Idrac, P. 216
Irwin, W. 63

Jackson, H. F. 70, 267, 282
Jameson, H. 164, 289
Jarrold, P. H. 43
Jaumotte, J. 211, 243
Jeffreys, H. ..47, 96, 112, 210, 282, 283
Jenkin, A. P. 211
Johnson, N. K. 7, 35, 53, 209
Johnston, H. 295
Jones, H. W. G. 159
Jones, J. R. G. 140
Jones, M. G. 212

Kähler, K. 211, 240
Kalitin, N. N. 68
Keen, B. A. 181, 212
Kelvin, Lord 93
Kidson, E. 40, 115, 221
Kimball, H. H. 162
Kirkwood, K. P. 36
Köppen, W. 130
Knight, W. A. 189, 262
Knoch, K. 149
Knox-Shaw, H. 258
Kühlbrodt, E. 82
Kulikowa, L. 94

Lamb, C. W. 70, 240, 258
Lamb, H. 210
Lampertico, D. 269
Lampland, C. O. 286
Learmouth, F. 122

PAGE

Lee, J. 85
Lempfert, R. G. K. 85, 99, 211, 239, 246
Lindemann, F. A. 17
Livett, G. A. 169
Long, W. H. 139
Low, A. R. 60
Lowe, E. J. 107

Mace, J. E. 246
MacLulish, J. M. 217
Mainwaring, J. P. 147
Maneyrol, A. 175
Margary, I. D. 137, 282
Margules, M. 129, 207
Markham, C. A. 20
Marloth, — 295
Marshall, C. 20
Marshall, R. 137
Martin, E. A. 65
Marvin, C. F. 83, 237
Massaux, Capt. 175
Matteuzzi, L. 81
Mauchly, S. J. 240
Maurer, J. 34
Maurin, C. 16
Max, A. 243
Mayers, A. E. 289
McAnally, H. W. W. 47
McLennan, J. C. 66
Mecking, L. 235
Meinardus, W. 150, 234
Mendenhall, C. E. 67
Mercanti, — 242
Merle, W. 20, 106
Merton, G. 211
Merton, Mrs. 211
Merz, A. 247
Meseguer, E. 81, 99
Mill, H. R. 150, 198
Mitchell, A. C. 247
Mitchell, W. G. W. 211
Mitchell, — 173
Mohn, H. 131
Mohorovičić, S. 282
Molchanoff, P. 81
Morey, F. 139
Mossman, R. C. 25
Mulholland, P. I. 21
Murphy, R. C. 93

Neville, E. H. 210
Newnham, E. V. 136, 169
Nicholson, D. W. 210
Nicholson, J. W. 210
Niven, J. 223
Nordenskjöld, O. 149
Nordhagen, R. 119

PAGE

Oberbeck, A. 131
Oglander, Sir J. 138
Okada, T. 6
Olley, G. P. 12
Owens, J. S. 162, 210
Owens, Mrs. 210

Pace, H. L. 70, 290
Paolini, B. M. 268
Parchinger, V. 93
Parkin, J. 116
Parkinson, W. C. 211
Parsons, F. J. 7, 90
Perez, J. V. 295
Pick, W. H. ... 70, 136, 193, 260, 285
Poggendorf, J. C. 2
Pollak, L. W. 271
Prentice, J. P. M. 146
Priestley, C. P. 285
Priestley, H. 284
Priestley, R. E. 119
Priestman, H. 270
Primavesi, R. H. 20
Proudman, J. 209

Quennell, W. A. 175

Ramsay, W. 270
Rashleigh, A. S. 214
Rayleigh, the late Lord 3, 254
Rayleigh, Lord 211, 257, 282
Read, R. S. 161
Reeves, E. A. 43
Richardson, L. F. 81, 96, 130
Roberts, D. 171
Roberts, O. F. T. 35
Robertson, C. L. 62
Robinson, E. E. 62
Rogers, H. A. 215
Rose, P. J. G. 122
Rotch, A. L. 205
Rowswell, B. T. 164
Russell, S. C. 214

Salter, M. de C. S. 65, 139, 198
Salter, M. J. 89
Sandström, J. W. 112, 130
Sarasola, S. 172
Sargeant, R. 245
Sassoon, Sir P. 86
Sawyer, L. D. 34
Schedler, A. 132
Schereschewsky, Ph. .....
Schio, A. da 269
Schmidt, W. 34, 130
Schott, G. 235

PAGE

Schuster, Sir A. 111
Schwarz, E. H. L. 240, 258, 262
Scott, G. H. 91
Scott, R. H. 245
Sempill, Col., The Master of 159
Sen, S. N. 136, 174, 281
Sewell, W. G. 240
Sewell, Mrs. 240
Shackleton, Sir E. 149
Shaw, J. J. 211
Shaw, Sir N. ... 58, 81, 205, 208, 212, 221, 234, 255, 256
Shrum, G. M. 66
Sidgreaves, W. 121
Silva, H. T. de 163
Silvester, N. L. 259
Simpson, G. C. .. 47, 81, 121, 150, 207, 240, 258
Single, S. 136
Smith, E. H. 229
Smith, F. E. 210
Smith, W. P. 211
Smith-Rose, R. L. 209
Solberg, H. 257
Somerville, J. J. 70
Spence, M. T. 98
Stagg, J. M. 281
Stanhope, R. M. 70
Stansfield, H. 210
Stevens, C. O. 259
Stewart, C. D. 32, 282
Stone, E. V. 70
Stüve, G. 57, 207
Sutton, J. R. 16
Sverdrup, H. V. 130
Swann, W. F. G. 209
Swoboda, G. 6, 33
Symons, G. J. 105, 271

Taylor, E. 279
Taylor, G. I. 34, 130, 198
Taylor & Francis 295
Targioni, G. 268
Targioni, O. 268
Teisserenc de Bort, L. 205, 207
Thomson, A. 148
Thomson, J. 2
Thomson, T. 210
Thoret, Lt. 75
Thorrowgood, W. J. 209
Tincker, M. A. H. 212
Tinn, A. B. 64
Tottey, W. H. 192
Tozzetti, T. 268
Troitsky, S. 68
Trout, A. M. 211

PAGE
Tucker, W. S. 18
Turner, H. H. 210
Turner, Mrs. & Miss 210
Twist, T. F. 221
Tymms, F. 158, 188
Tyndall, A. M. 210
Tyndall, J. 18, 65

Vallot, J. 99
Varley, F. J. 39, 139
Vegard, L. 66
Vercelli, F. 270
Vernard, Sergeant 75
Visher, S. S. 22

Walford, E. W. 65
Walker, A. O. 63, 88
Walker, Sir G. .. 81, 99, 111, 129, 174, 209, 223, 258, 259
Wallén, A. 6
Walter, A. 147
Ward, R. de C. 277, 293
Warden, R. C. 199, 247
Watkin, E. L. 211
Watson, G. M. 75, 121
Watson, R. E. 211, 240
Weber, W. H. 2
Webster, D. L. 67
Wegener, A. 82
Wehrlé, P. 81
Weinberg, B. 84
Weise, W. 234, 258
Welsh, J. 72
Weston, G. 88
Whipple, F. J. W. ..6, 9, 17, 38, 57, 87 118, 165, 211, 239, 293
Whipple, R. S. 211
Whitbread, S. C. 86
Whitehead, R. 115
Wiley, J., & Sons, ... 22
Willis, J. H. 139
Wilson, C. T. R. 47
Wilson, S. 284
Winning, J. G. 242
Wood, J. G. 271
Wright, C. S. 119
Wright, G. A. 193

Zandt, J. P. van 243
Zealley, P. R. 165

ILLUSTRATIONS

PAGE
Railway Disaster in the Owencarra Valley, North Ireland ..... *Frontispiece*
Thames Valley rainfall and floods 15
Pressure deviations from normal, August 24th to January, 1925 30
Sloane Square station ..... *to face p.* 41
Aberdeen pressure deviations, December 8th, 1924 44
Autographic records with open time scale, Porton and Leafield 55
Synoptic chart, 18h., February 11th, 1925 56
Recurrent cloud pendant 61
International Commission for the Investigation of the Upper Air .. *to face p.* 81
Sketch of the variations of rainfall in Britain since 1000 A.D. 109
Dr. C. Chree, F.R.S. ..... *to face p.* 120
George Marwood Watson, 1897-1925 ..... *to face p.* 121
Rainfall autographic record, July 14th, 1917 139
Pilot Balloon Ascents at Colombo, Ceylon ..... *to face p.* 163
Halo at Guernsey, July 3rd, 1925 215
Synoptic chart, 18h., March 31st, 1925 219
Baragraph trace, Roebourne, January 21st-22nd, 1925 220
Source of icebergs and their drift into the North Atlantic 231
Winter Thunderstorms 261
Diagram of blades of vane of Cierva Autogyro 280
Cierva Autogyro, 1925 ..... *to face p.* 280
Salt Island 291

SUBJECT INDEX

Meteorology—General :—

Official Notices :— PAGE

Airships, Meteorology Division, Formation of 32
Beaufort Weather Letters, b, bc, c and o 133
British Climatology and General Climatology Divisions, Formation of the 110
Change of Assistant Directors 87
Change of Editor of Meteorological Magazine 110
Course of Training for Observers 41
Crop-weather stations 212
Discussions at the Meteorological Office 211
Distributive Stations of the Meteorological Office 70
Publication of Observations made at the Observatories of the Meteorological Office 148
Retirement of Dr. Chree 87,120

Official Publications :—

Advisory Committee for Atmospheric Pollution, Tenth report on the.... 161
Barometer Manual for the Use of Seamen..... 212
Geophysical Memoirs, Vol. III., Nos. 23-27 ..... 110, 111, 136, 281
Hygrometric Tables for the Computation of Relative Humidity, Vapour Pressure and Dew Point 32
Professional Notes, Vol. 3, Nos. 38-40 ..... 32, 33, 136
,, ,, Vol. 4, Nos. 41-43 ..... 136, 257, 281
Weather Map 256

Biography, History, Etc. :—

Local Rainfall Associations 19
Retirement of Mr. A. L. C. Hands 147

Appointments and Awards :—

C.B. awarded to Mr. J. P. G. Rose 122
Curator of Library and Museum of Royal Society of Edinburgh, Dr. A. C. Mitchell appointed..... 247
Degree Ph.d. obtained by J. Glasspoole 75
Honorary Degree LL.D. conferred on Dr. G. C. Simpson 47
Howard Prize awarded to Cadet H. W. Barnett 200
Institution Premium, 1924. Award to J. Glasspoole 115
Jacksonian Professorship of Natural Philosophy, Cambridge. Mr. C. T. R. Wilson appointed to 47
K.B.E. awarded to Vice-Admiral Learmonth 122
Meteorological Committee, Capt. W. Ellery appointed to 247
,, ,, Lt.-Col. J. U. Hope appointed to 122
Royal Society, Election of Dr. H. Jeffreys into the..... 47
Spanish Meteorological Service, Col. E. Meseguer appointed as Director of the 99
Symons' Gold Medal, Award to Lt.-Col. E. Gold 271

Societies, Lectures, Collections, Etc. :—

British Association for the Advancement of Science, Southampton, August 26th to September 2nd, 1925 206
Climatological Congress at Davos 109
Course of lectures by Sir G. T. Walker during the session, 1925-6..... 223

Meteorology—General—*cont.*

Societies, Lectures, Collections, Etc. :—cont. PAGE

International Air Congress. The Third. F. E. 242
International Commission for the Investigation of the Upper Air..... 81
Local Rainfall Associations 19
London Mathematical Society. Lecture by Dr. Jeffreys before the.... 47
Meteorological Demonstration at Chester. H. F. Jackson 267
Meteorological Exhibit at the Highland and Agricultural Society's show at Glasgow, July 14th to 17th, 1925 170
Meteorological Office. Discussions at the :—

PAGE

Etude sur les microséismes (Observatoire de Zi-ka-wei, 1924) 5
La prévision scientifique du temps..... 5
Wellen und Wirbel an einer quasistationären Grenzfläche über Europa 33
Diagnostic and prognostic application of mountain observations 57
Die Schwankungen der atmosphärischen Zirkulation über dem Nordatlantischen Ozean im 25-jährigen Zeitraum 1881-1905 239
Die atmosphärischen Elektrizität über den Meeren 240
The light of the night sky, its intensity variations when analysed by colour filters..... 257
The Kalahari Project 258
Ozone as an absorbing material for radiations in the atmosphere 281

Meteorological Society, The Royal :—

PAGE

Election of Honorary Members and presentation of Buchan Medal 6
Presidential Address..... 7
The effect of pressure distribution upon London's sunshine in winter 34
On the changes of temperature in the lower atmosphere, by eddy conduction and otherwise 34
The measurement of the lapse rate of temperature by an optical method 35
The energy of saturated air in a natural environment 58
On the relation between the source of the air and the upper air temperature up to the base of the stratosphere 59
Waves at an approximately horizontal surface of discontinuity in the atmosphere... 59
The 75th Anniversary of the Royal Meteorological Society 85
On periodicity 111
On fluid motions produced by differences of temperature and humidity 112
Further remarks on the meteorological conditions of the Pleistocene Epoch, with a note by C. E. P. Brooks 112
Gustiness of wind in particular cases..... 113
Report on the Phenological Observations in the British Isles from December, 1923, to November, 1924 137
Measurements of the amount of ozone in the upper atmosphere 137
Meteorological Periodicities of the order of a few years and their local investigation; with special reference to the term of 5·1 years in Britain 137
Measuring the sun's rays 258
On correlation coefficients: their calculation and use 259
Note on the variations in transparency of the atmosphere observed by means of a projected telescopic image of the sun..... 259
Notes on the behaviour of certain plants in relation to the weather 259
The Mursham phenological record in Norfolk, 1736-1925, and some others 282
Experiments on the shielding of rain gauges 283
On the dynamics of geostrophic winds..... 283

Royal College of Physicians of Edinburgh, The Parkin Prize of the 116
Royal Society, Reprints of papers from the Proceedings of the 95
Royal Society of Arts, Lecture by Sir G. T. Walker before the 99

Foreign Institutions :—

Colombian Meteorological Service 172
Floating Weather Bureau. A, ... 171
Forecasting service in Italy. A new 244
Samoa, Apia Observatory 148
Ukraine Meteorological Service 46

Expeditions, Contests, Etc. :—

Amundsen's Polar Flight, R. S. R. 160
Deutschen Antarktischen Expedition, 1911 to 1912. Die Ergebnisse der meteorologischen Beobachtungen der. H. R. Mill 149
King's Cup Air Race. F. E. 157

Meteorology—General—*cont.*

Expeditions, Contests, Etc.:—cont.

PAGE

Oxford University Arctic expedition, Meteorological results of the 187
Prof. W. H. Hobbs' expedition to Greenland 271
Record gliding flights 75, 175

Reviews:—

PAGE

ABBOT, C. G.—Solar Variation and Forecasting 237
BALDWIN, H. I.—Narrow climatic adaptability of forest tree seed 267
BARKOW, E.—Die Ergebnisse der meteorologischen Beobachtungen der Deutschen Antarktischen Expedition 1911-1912. H. R. Mill 149
BOEREMA, J.—Regenval in het Noordelijk deel van Sumatra's Oostkust. J.G. 198
BOND, W. N.—An introduction to fluid motion. D. Brunt 197
BRAAK, C.—Het Klimaat van Nederlandsche-Indie, Parts 6, 7 and 8 ..... 45, 294
BROOKS, C. E. P.—The evolution of climate. 2nd edition 119
BROOKS, C. F.—Why the weather? M. T. Spence 97
BUREAU, R., AND COVECQUE, M.—Les atmosphériques sur les océans. Leurs caractères météorologiques 266
CANNEY, E. E.—Rain-grown cotton and climate 70
CASELLA, C. F., & Co., LTD.—New catalogues 71
CASELLA, C. F., & Co., LTD.—New price list of barometers 294
CASTENS, G.—Uber Tropenklimatologie, Tropenhygiene und den Lettow-Feldzug.. 221
CLAYTON, H. H.—Solar radiation and weather 237
COVECQUE, M., AND BUREAU, R.—Les atmosphériques sur les océans. Leurs caracteres météorologiques 266
DANISH NAUTICAL-METEOROLOGICAL ANNUAL 1924 95
EXNER, F.—Dynamische Meteorologie. Sir G. T. Walker 129
FORD, C. D.—Irrigation in S. Africa 94
FRITH, E.—The atmosphere and its story... 74
GUDRIS, N., AND KULIKOWA, L.—Die Verdampfung kleiner Wassertropfen 94
HOWARD, L.—Barometrographia and Lectures on Meteorology 72
HOXMARK, G.—Solar radiation and the weekly weather forecast of the Argentine meteorological service 237
KESWICK DIARY OF THE EIGHTEENTH CENTURY. P.I.M. 20
KULIKOWA, L., AND GUDRIS, N.—Die Verdampfung kleiner Wassertropfen 94
PAOLINI, B. M.—La Meteorologia Agraria in Italia. H.W.L.A. 268
PEREZ, J. V.—A selection of Botanical and other papers 295
RAMSAY, W.—The probable solution of the climatic problem in Geology 270
SARASOLA, S.—Noticia del nuevo observatorio de Colombia 172
SCHWARZ, E. H. L.—The Kalahari Project.. 262
TROÏTSKY, S.—Quelques données sur la question du développement et de la propagation verticale des ondes aériennes.... 68
VISHER, S. S.—Climatic Laws 22
WALKER, SIR G. T.—Correlation in seasonal variations of weather, Parts IX. and X... 174
WALTER, A.—Relation between sugar crops and weather 147
WARD, R. DE C.—The Climates of the United States 277
WARD, R. DE C.—The importance of field work in the study of climates 293

Obituary:—

PAGE

BOMMER, J. 122
BRODIE, F. J. 200, 245
CALWAGEN, E. G. 175
CARPENTER, A. 98
CHILLMAN, W. R. C. 247
CLARK, W. S. 270
CORTIE, A. L. 121
DYER, J. M. 75
FLAMMARION, C. 122
FRIEDMANN, A. A. 247
HILDEBRANDSSON, H. H. 175, 205
MACE, J. E. 246
MERZ, A. 247
NIVEN, J. 223
VALLOT, J. 99
WARDEN, R. C. 199
WATSON, G. M. 75, 121

Meteorological Office, Staff News:—

Air Ministry Tennis Tournament 175
Annual Soirée, 1925 47
Change of Assistant Director 87
Retirement of Dr. Chree 120
Shoeburyness Staff Dinner 23
Social Gathering at Edinburgh 295

Meteorology—General—*cont.*

Miscellaneous :— PAGE

Airship R. 33 ..... 68, 90
Early Weather Records :—
Isle of Wight Weather in the 17th century. F. Morey 138
Keswick Diary of the eighteenth century. P.I.M. 20
Some works by Luke Howard 72
Unusually severe weather in 1684 145
Kite Record 119
Lesson of the Grimy Bridge 41, 94
Meeting of Civil Servants on November 17th 247
Parkin Prize, The 116
Rotor Ship, The 42
Subscriber to Daily Weather Reports for fifty years 295

Observatories and Stations :—

Apia Observatory Samoa, ... 148
Crop-Weather Stations 212
Distributive Stations of the Meteorological Office 70
Greenland Stations 82
Jakutsk Geophysical Observatory 199
Jan Mayen 42
Mont Blanc Observatory 99
St. Helena 147

Methods of Observation and Computation :—

Beaufort Weather Letters, b, bc, c and o 133
Comparison of rainfall at neighbouring stations 143
Correlation between crops, soil-moisture and temperature in Mauritius .. 147
,, co-efficients ; their calculation and use 259
,, in seasonal variations of weather, Parts IX. and X. 174
Measurement of the lapse rate of temperature by an optical method 35
Meteorological periodicities of the order of a few years and their local investigation ; with special reference to the term of 5·1 years in Britain 137
Method of keeping balloons at stated heights 218
Periodicities in the weather. Abstract of D. Brunt's address on 209
Periodicity. On 111
Possible errors in annual rainfall totals obtained by the summation of daily records. M. J. Salter 88
Pressure record given by the Dines' type of baro-thermograph. Note on the accuracy of the 287
Use of very open time scales 53

Instruments :—

Barometer. On the design of the Kew Pattern 281
Barometers. A new price list of 294
Campbell-Stokes sunshine recorder. F. J. Parsons 7
Comparison of anemometer exposures at Holyhead 290
Device for observing with a theodolite at night 43
Dines' anemograph at Hong Kong. Calibration of 11
Errors in sunshine spheres ; preliminary note 265
Meteorological instruments 71
Nephoscope. A new form of 195
Pilot Balloon, Expansion of a. C. B. 289
Rain gauges. Experiments on the shielding of 283
Tapered rain measures 265
Tetrahedral pilot balloon for high ascents. S. W. Sen 172
Thermometers. Some effects produced by protective shields on the readings of grass minimum 281

Physics of the Atmosphere :—

Acoustic clouds 18
Advisory Committee on Atmospheric Pollution. Tenth report of the .. 161
Convective Circulations in the atmosphere. By D. Brunt 1, 59
Diagnostic and prognostic application of mountain observations 57
Energy of saturated air in a natural environment 58
Exner's Dynamische Meteorologie. The new edition of. By Sir G. T. Walker 129
Explosions at La Courtine. The sound of the. F. J. W. W. 16
Fluid Motion. An introduction to. D. Brunt 197
Fluid motions produced by differences of temperature and humidity 112
Haze in the East Indies 45
New Ideas in meteorology. Abstract of Dr. Simpson's address 207
Outstanding problem in meteorology. By D. Brunt 253
Ozone in the upper atmosphere. Measurements of the amount of 137
Transparency of the atmosphere observed by means of a projected telescopic image of the sun. Note on the variations in 259
Trigger action in the atmosphere. Abstract of Sir N. Shaw's address 208
Visibility and Convection. Ground horizontal : W. H. Pick 260
,, at Cranwell. A remarkably quick change of 285
,, at Spitsbergen 188
Waves at an approximately horizontal surface of discontinuity in the atmosphere 59

Investigation of the Upper Atmosphere :—

Air Congress. Third international. F. E. 242
Airship R 33 ..... 68, 90
Amundsen's Polar Flight. Meteorological conditions. R. S. R. 160
Cierva Autogyro. E. Taylor 279
Free atmosphere. Wind fluctuations in the 68
Height reached by balloon at Kew Observatory, April 21st 99
International Commission for the investigation of the upper air 81
Investigation of the winds in the upper air from information regarding the place of fall of pilot balloons and the distribution of pressure 257
King's Cup Air Race. Meteorological conditions. F. E. 157
Kite Record 119
North and south winds cancel. L. H. G. D. 43
Pilot balloon ascents at Colombo, Ceylon. H. Jameson 163, 289
Relation between the source of the air and the upper air temperature at the base of the stratosphere 59
Soaring flight of the albatross 216
Trajectories of upper air currents. J. Durward 217
Upper air circulation of the Atlantic Ocean 33
,, wind velocities by observations of artificial clouds. The measurement of 32
Vertical currents 195

Cosmical Relations :—

Eclipse readings. H. N. ffarington 9
Measurement of planetary radiation 286
Measuring the sun's rays 258
Weather forecasting with the help of the sun 237

Optical Phenomena :—

Buddha's Glory. J. E. Clark 240
Crepuscular Rays. W. A. Knight 189
E. W. Barlow 202
C. F. Priestley 284

Optical Phenomena :—*cont.* PAGE

Curious optical phenomenon. J. G. Winning 241
Green flash. The 136
Light of the night sky, its intensity variations when analysed by colour filters 257
Lunar rainbow and eclipse. R. P. Dansey 40
Remarkable halo at Guernsey, July 3rd, 1925. C. E. P. Brooks..... 215
" Spectre of the Brocken " in Lakeland. J. E. Clark 165

Atmospheric Pressure :—

Abnormal pressure in Rhodesia. C. L. Robertson 62
Atmospheric pressure. The control of fire-damp by 16
" Derby Day Weather." C. K. M. D. 117
High barometer and heavy rain. R. D. Dansey..... 10
,, ,, ,, A. B. Tinn..... 63
Pressure distribution in relation to weather, September, 1924, to February, 1925 (*illus.*). By C. E. P. Brooks 29
,, ,, over the North Atlantic, 1881-1905. The classification of the 239
,, ,, upon London's sunshine in winter. The effect of.. 34
,, record given by Dines' type of baro-thermograph. Note on the accuracy of the 287
Quick fall of pressure at Roeburne, Australia 220
Series of pressure waves shown by photo-barogram 44
Waves at an approximately horizontal surface of discontinuity in the atmosphere 59

Temperature and Radiation :—

Temperature :—

Are Winters changing ? C. Harding 113
S. S. Burlingham 140
A. H. Hookham 141
Changes of temperature in the lower atmosphere by eddy conduction and otherwise 34
Earth temperatures at Odessa..... 46
International Ice Patrol (*illus.*). By Lt.-Comdr. E. H. Smith 229
Measurement of the lapse rate of temperature by an optical method..... 35
Mildness of winters on the North Wales coast. S. Wilson..... 284
Relation between the source of the air and the upper air temperature up to the base of the stratosphere..... 59
Tephigrams 83
Thermal structure of the atmosphere..... 207
Unusually severe weather in 1684 145

Radiation :—

Light of the night sky, its intensity variations when analysed by colour filters 257
London's sunshine in winter. The effect of pressure distribution upon.. 34
Radiation effects. The time scale of..... 255
,, measured at Benson, October, 1924, to September, 1925.. 17, 96, 170, 244
Variations in the calculated solar constant 237

Aqueous Vapour and Rain :—

Aqueous Vapour :—

Cloud formations. Notable..... 215
Convective circulations in the atmosphere. D. Brunt 1, 59

Aqueous Vapour and Rain—*cont.*

Aqueous Vapour :—cont. PAGE

Cumulus cloud and ground horizonal visibility. W. P. Pick 260
Dew Pond Myth. E. A. Martin 64
Evaporation of small waterdrops 93
Fog of January 10th and 12th, 1925. L. C. W. Bonacina 7
F. J. W. Whipple 9
Haze in the East Indies 45
Hygrometric Tables 32
Mammillated Clouds. Types of. E. Kidson 39
Mammato-cumulus clouds. R. Whitehead 115
,, ,, ,, at Cranwell. W. H. Pick and G. A. Wright .. 193
,, ,, ,, Frequency of. S. C. Russell..... 214
Personal investigation of a squall cloud..... 67
Recurrent cloud pendant. E. E. Robinson 60
Sea fog over land. F. J. W. W. 118
P. R. Zealley 165
When is most dew deposited ?..... 93

Rain :—

Drizzle under a clear sky (*illus.*) 43
Drought at Guernsey, The June. B. T. Rowswell..... 164
,, in western Anatolia. K. P. Kirkwood 35
,, , its prevention and cure 262
Dry June of 1925. J. G. 142
Localised Precipitation. A. J. Dexter 37
Long Arm of Coincidence. J. G. 69
Rain at Cattewater, Heavy fall of. August 6th, 1925 199
,, , Excess of salt in. W. Irwin 63
,, from a blue sky. T. H. Applegate 194
,, with high barometer, Heavy. R. P. Dansey 10
A. B. Tinn 63
Rainfall at neighbouring stations, Comparison of 143
,, at Ross-on-Wye, Abnormal 89
,, at the Isle of Wight, Heavy. August 23rd, 1925 223
,, General distribution, 1925 ..... *monthly*
,, , Heavy..... 293
,, in Rhodesia, Abnormal. C. L. Robertson 62
,, in the Isle of Wight, The average 92
,, of Great Britain, Long period variations in the (*illus.*). By C. E. P. Brooks 105
,, of Paris and London..... 196
,, of very rare intensity. F. J. Varley 38
J. H. Willis 139
,, of 1925 292
,, records. S. H. Bickham 10
,, tables for 1925 ..... *monthly*
,, totals obtained by the summation of daily records, Possible errors in annual. M. J. Salter 88
,, , Totland Bay. J. Dover 213
Regenval in het Noordelijk deel van Sumatra's Oostkust 198
Trigger action in the atmosphere 208

Solid Precipitates :—

Great hailstorm, Windsor Park, March 1st, 1925. L. C. W. Bonacina.... 36
Heavy hail showers over S.E. England, July 22nd, 1925. E. V. Newnham 168
G. A. Livett .. 169
Heavy snowstorm at Mansfield 271
Snowless winter of 1924-5. R. P. Dansey 139

Aqueous Vapour and Rain—*cont.*

Hydrology :— PAGE

Clearness of Thames water after floods 16
Drought, its prevention and cure 262
Floods in Peru 92, 118
,, in the Thames Valley 14
Scope of irrigation in South Africa 94

Wind :—

Gales at the end of 1924 14
Geostrophic winds. On the dynamics of 283
Gustiness of wind in particular cases 113
Lesson of the Grimy Bridge 41, 94
Long Flight, A 218
Measurement of upper wind velocities by observations of artificial clouds 32
North and South Winds cancel. L. H. G. D. 43
Rotor Ship, The 42
Soaring flight of the albatross 216
Strong leeside eddy in the Lake district. R. W. Hall 10
Surface and geostrophic wind components at Deerness, Holyhead, Great Yarmouth and Scilly 136
Vertical currents 196
Wind and Light railways (*illus.*) 12
Wind and Tide ..... 211.

Cyclones, Storms, Anticyclones, Etc. :

Line-squall. January 31st, 1925. M. W. Binns 11
Plunge through a line-squall, A 12
A. O. Walker 62
T. H. Applegate 87
G. Weston 88
Some characteristics of a cold front, February 11th, 1925 (*illus.*) 53
Squall cloud, A personal investigation of a 67
Thunder coming up against the wind. L. C. W. Bonacina 167
Thunderstorm at The Hague, December 10th. J. E. Cowper 285
,, of March 1st, 1925. L. C. W. Bonacina 37
Thunderstorms in the East Indies 45
,, , May. C. K. M. D. 116
,, over S.E. England, July 22nd, 1925, E. V. Newnham .. 168
G. A. Livett 169
,, over the Globe, Distribution of 111
,, , The course of 72
,, , Winter. S. M. Bower 260
Tropical cyclone in Western Australia. E. Kidson 220
Typhoon at Hong Kong. J. J. Claxton 11
Waterspouts observed at the Isle of Man. W. H. Tottey 192
Wellen und Wirbel an einer quasistationären Grenzfläche über Europa .. 33

Atmospheric Electricity :—

Atmosphärischen elektrizität über den Meeren 240
Atmospheric electricity : the meteorological significance of atmospherics over the sea 266
Ball lightning observed at Norwood 162
Extent of a flash of lightning. A. S. Rashleigh 213
Green component in auroral light 66
Is lightning less dangerous in the Tropics 45
Red lightning. H. A. Boys 191

Climatology and Weather :—

Atmosphere and its story. The 74
Border line between meteorology and soil physics. B. A. Keen 181

Climatology and Weather :—*cont.* PAGE

Climate, The evolution of 119
Climates, Importance of field work in the study of 293
,, of Paris and London, The 196
Climatic laws—a summary of climate 22
,, problem in Geology, Probable solution of the 270
,, zones, Trees and 267
Climatological Table for the British Empire ..... *monthly*
,, ,, ,, ,, reference table 155
Climatology of Glasgow 110
,, of the United States 277
Further remarks on the meteorological conditions of the Pleistocene epoch 112
Health and the Tropics 221
Meteorologia Agraria in Italia. H. W. L. A. 268
Mursham phenological record in Norfolk, 1736-1925, and some others .. 283
Phenological Observations in the British Isles from December, 1923, to November, 1924. Report on the 137
Possible cotton-growing areas 70
Weather and Sugar Crops 147
,, at Ross-on Wye, Abnormal. F. J. Parsons 89
,, Derby Day. C. K. M. D. 117
Weather in relation to pressure distribution, September, 1924, to February, 1925 (*illus.*). By C. E. P. Brooks 29
,, in Rhodesia, Abnormal. C. L. Robertson 62
,, in the North Atlantic, Seasonal variations of 209
,, in the 17th century, Isle of Wight. F. Morey 139
,, Notes on the behaviour of certain plants in relation to the..... 259
,, of 1925 ..... *monthly*
Why the Weather ? 97

Weather Forecasting :—

Classification of synoptic charts for the North Atlantic for 1896 to 1910 .. 136
Floating Weather Bureau 171
Forecasting in India, Application of world weather correlation to seasonal 174
,, of ice in the North Atlantic. Lt.-Comdr. E. H. Smith .. 235
,, with the help of the sun, Weather 237
Prévision scientifique du temps 5

Terrestrial Magnetism and Seismology :—

Etude sur les microséismes (Observatorie de Zi-ka-wei, 1924) 5
Terrestrial magnetism and seismology at the Meteorological Office Observatories 18

Astronomy :—

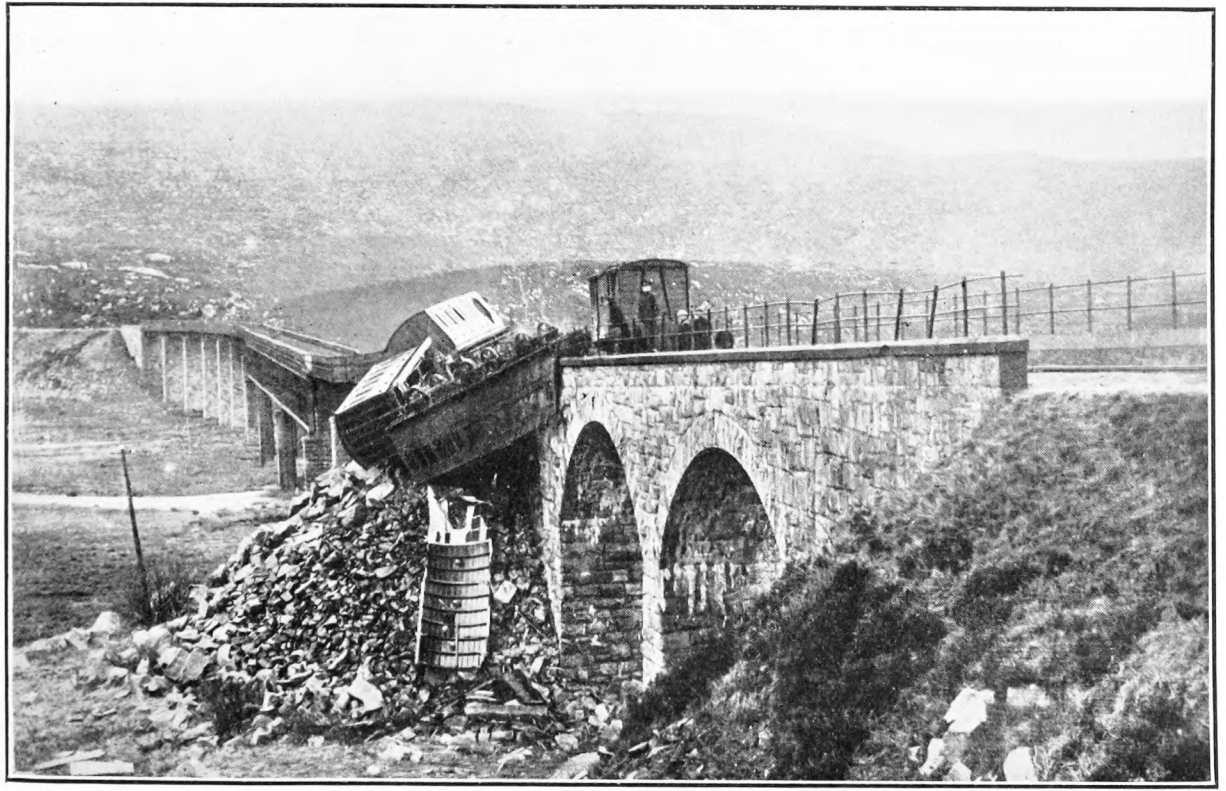
Eclipse and Lunar rainbow. R. P. Dansey 40
Lost opportunity, A 145
Meteoric fireballs. W. F. Denning..... 190
Unusual lunar eclipse. C. M. Enriquez 166

ERRATA.

Vol. 59, January, 1924, p. 289, line 30, *for* " 200 ft. above sea level," *read* " 300 ft. above sea level."

Vol. 60, page 7, line 23, *for* " severest gusts," *read* " severest frosts."
page 49, line 42, *for* " Rainfall January " *read* " Rainfall February."
page 96, line 14, *for* " Oxon, 1924," *read* " Oxon, 1925."
page 272, line 18, *for* " Snowden (Carmarthen)" *read* " Snowdon (Carnarvon)".

See also pages 99, 194, 247.



RAILWAY DISASTER IN THE OWENCARRA VALLEY, NORTH IRELAND,
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Convective Circulations in the Atmosphere

By D. BRUNT, M.A.

AN interesting phenomenon relating to the stability of horizontal layers of fluid can be demonstrated by pouring a small amount of cheap gold paint into a metal ash-tray, filling it to a depth of two or three millimetres. The cheaper varieties of gold paint contain a certain amount of benzene or other volatile constituent, which evaporates vigorously from the surface, producing a cooling of the surface layer, and therefore yielding an unstable state. When the fluid is first poured into the tray, we notice the existence of a very large number of centres at which vigorous ascent of fluid takes place. In a few seconds the number diminishes, leaving the fluid divided into polygonal prismatic cells, each of four to seven sides. The diameter of the polygons is about three times the depth of the fluid. There will be a number of smaller cells which will be squeezed out of existence by the larger cells, and after about half a minute the structure will have settled down to a relatively permanent form.

If attention is concentrated on a single polygonal cell it will be noted that there is vigorous ascent in the central region, and descent at the outer edges, with outflow in between. The return inward current is in the bottom layers of the fluid. The small solid particles (presumably bronze) can be seen to be in rapid motion within each separate cell, but there is a small region in the centre of each cell which is clear of solid particles,

Wt 69—P 1 1000 2/25 M & C

and around the periphery there is a narrow belt of clear fluid.

The cell circulation continues so long as there is evaporation from the surface, but the circulation can be stopped by covering the tray with a piece of glass. When the glass cover is removed the evaporation recommences, and the polygonal structure again becomes distinct. The pattern can at any time be destroyed by shaking the tray. If the tray is tilted it will be noted that the cells are larger in the deeper fluid, and diminish in size towards the shallow edge. By adjustment of the amount of fluid in the tray it is possible to show, not only that the polygons increase in size with increasing depth of fluid, but also that on the shallow side the structure abruptly terminates with cells of a finite size, leaving a shallow layer of fluid which is clear of cellular structure. In the course of a few minutes most of the solid particles will have been deposited on the bottom of the tray, and if the tray be very quietly shaken it will be found that the polygonal cells which form in the now shallower layer of fluid will be smaller than before.*

The phenomenon described above was first described by W. H. Weber in Poggendorf's *Annalen*,† the cellular structure being observed in a layer of alcohol and water on a microscope slide. It was also described by James Thomson in a paper entitled "On a Changing Tesselated Structure in Certain Liquids."‡ Thomson observed a similar structure in layers of soapy water, 4 or 5 inches deep, cooled from the surface. The same phenomenon has been observed in widely different fluids by Frankenheim and Bénard. The investigations of Bénard were carried out with very carefully adjusted apparatus, and yielded some very striking results. In some of Bénard's photographs, the individual cells are shown as perfect hexagons. Bénard generally worked with layers of fluid of about 1 mm. in depth, and he used a variety of liquids, in each case maintaining a known difference of temperature between the top and bottom of the layer. Bénard's experiments and results are fully described in "Les Tourbillons Cellulaires dans une Nappe Liquide," a thesis for the degree of Doctor, published by Gauthier-Villars, 1901. Bénard also found that if the fluid had a general flow in one direction when instability was first set up, the cells were drawn out into long strips, parallel to the direction of flow. This phenomenon can be obtained roughly with gold paint by moving the tray to and fro.

* The reader who is interested in this experiment is strongly advised to try it for himself. The total cost of a bottle of gold paint and a tray will not exceed 7d. There is a commercial preparation called "Avenue Liquid Gold," whose use was recommended by Mr. Gibson, Air Ministry, which gives excellent results. A small tray such as is used for baking mince-pies can be used for the experiment.

† *Annalen d. Physik u. Chemie. Bd.* XCIV, 1855, *p.* 452.

‡ Glasgow, Proc. Phil. Soc., 1881-2.

The underlying physical processes were discussed by the late Lord Rayleigh in a paper " On Convection Currents in a Horizontal Layer of Fluid, when the Higher Temperature is on the Under Side."* Rayleigh based his discussion on the consideration that when a system falls away from unstable equilibrium, it may do so in several principal modes, in each of which the departure at time t is proportional to the small displacement of velocity supposed to be present initially, and to an exponential factor e^{qt} where q is positive. If the initial disturbances are small enough, that mode (or modes) of falling away will become predominant for which q is a maximum. Rayleigh's main results may be briefly stated as follows :—

(1) If ρ_1, ρ_2 be the densities of the fluid at the bottom and top of the layer whose thickness is h, stable equilibrium is possible with the denser fluid above, so long as :—

$$\frac{\rho_2 - \rho_1}{\rho_1} < \frac{27\pi^4 K\nu}{h^3}$$

where K is the coefficient of thermal conduction, and ν the coefficient of viscosity.

(2) When the cellular circulation is set up, if the separate cells are squares, the side of the square is $2\sqrt{2}$ h.

(3) For hexagonal cells, the diameter of the circle inscribed in the hexagon is a little greater than $3\frac{1}{2}$ h.

(4) For fluid with a general flow, the width of the strips is twice the depth of the fluid.

Rayleigh's discussion thus affords a complete explanation of the results derived with gold paint as described above, viz. : when the dish is tilted, the cells are bigger in the deeper fluid and there is a shallow layer in which no cells are formed. The meaning of the formula given in (1) above is that in a fluid which has a finite conduction of heat, and a finite coefficient of viscosity, the effect of conduction in wiping out local deviations of temperature and of viscosity in damping out small velocities, is to maintain stability under conditions which would otherwise be regarded as unstable.

Rayleigh's discussion applies only to incompressible fluid and is therefore not directly applicable to air, but it at once suggests by analogy an explanation of the occurrence of superadiabatic lapse rates in the atmosphere. Rayleigh shows that, neglecting compressibility, a difference of 9° C. is consistent with stability in a layer of air 1 cm. in thickness. It follows that in a layer of air 1 metre in thickness, the difference of temperature (neglecting compressibility) which could exist, would be a very small fraction of a degree. Now, it is known that in air the transfer of heat by molecular conduction is in practice negligible by comparison with the transfer of heat by radiation and absorption,

* *Phil Mag.* *Vol.* XXXII, *Dec.*, 1916, *p.* 529.

and it is suggested that in Rayleigh's inequality in (1), above, the coefficient of conduction K should be replaced by a much larger coefficient to represent the effect of absorption and radiation. I am at present endeavouring to obtain a similar inequality for compressible fluid, allowing for absorption, but for the moment we shall have to be satisfied with using the analogy suggested by Rayleigh's result. This analogy is very attractive, since it appears to explain the fact that a considerable degree of nominal instability can be built up in the atmosphere. The existence of very large lapse-rates is at times denoted by the formation of mirages. As another example we may cite the case of thunderstorms, which are preceded by a vertical distribution of temperature corresponding to a mean lapse rate largely in excess of the adiabatic, the thunderstorm forming with great suddenness, suggesting that the lapse rate attains a critical value beyond which equilibrium is impossible.

But, apart from the question of the physical process of formation of apparently unstable vertical distributions, the form of falling away from unstable equilibrium discussed by Rayleigh and others, and illustrated by the experiment with gold paint described above, is of frequent occurrence in meteorological phenomena. An obvious case is that of mammato cumulus clouds, in which the instability is probably due to the descent of cloud, with a layer of clear air beneath. The clear air is warmed at the dry adiabatic rate, while the cloud is warmed at the wet adiabatic rate, and so leads to instability, and the breakdown of the unstable condition in a number of small cells is very well illustrated in typical photographs of mammato cumulus cloud. The explanation of the structure of the mammato cumulus cloud here offered would require that the instability should be restricted to a relatively thin layer. Photographs of alto cumulus also show a similar structure. Other varieties of cloud which show small globular structure may possibly be ascribed to the same process. The gradation of size of the globules frequently noticed in high clouds would then be ascribed to a gradation of thickness of the layer through which instability occurs.

In the observations of Bénard and others, the lower boundary of the layer of fluid is a solid layer, and the motion is upward at the centre of each cell. In the case of an unstable layer in the atmosphere at some height above the ground, the bounding surfaces are both interfluid surfaces, and there is no obvious criterion for determining whether the motion should be upward or downward at the centre of each cell. It is worthy of note that an unstable condition may be produced in the atmosphere by the descent of a layer of dry air with a layer of cloud above it, or by the ascent of a layer of dry air with a layer of cloud below it. In either case, if the instability is restricted to a shallow

layer, the breakdown of equilibrium will take the cellular form, and any resulting cloud will be of a flocculent form.

There are probably many other meteorological phenomena which are capable of explanation by the same cellular mechanism. The examples cited above suffice to show that the principle is one capable of application to widely different fluids, and therefore merits the attention of meteorologists.

Discussions at the Meteorological Office

January 19th, 1925. *Étude sur les microséismes* (*Observatoire de Zi-ka-wei*, 1924). By R. P. E. Gherzi, S.J. (Zi-ka-wei—Changhai). *Opener*—Capt. H. W. L. Absalom.

It is a remarkable feature of seismographic records that they show the earth to be subject to continual tremors obviously different from earthquakes in character as well as in magnitude. It was suggested long ago that these tremors or microseisms might be due to waves beating on distant coasts, or that they were associated in some other way with the weather. By his study of the records of the Zi-ka-wei Observatory, Father Gherzi has been led to the further conclusion that microseismic disturbances may be grouped into various classes: (1) those due to cyclones, (2) those due to anticyclones, (3) those due to cold, and (4) those due to other causes. Each of the three definite classes has its own type of microseismic record. It remains to be seen whether similar associations are to be traced in other parts of the world. If they can, it will be clear that the mechanism of microseismic activity is primarily meteorological.

February 2nd, 1925. *La prévision scientifique du temps*. By G. Guilbert (Paris, 1922). *Opener*—Mr. G. R. Hay.

The name of M. Gabriel Guilbert has been familiar to English meteorologists since he won the international forecasting competition at Liège in 1905, and it was announced that his success was due to his use of a certain set of empirical rules. During and since the War, M. Guilbert has elaborated his system by incorporating some of the rules based on the movement of clouds to which so much importance is attached by French meteorologists of the Delcambre school. In the work under discussion, the author defends his claims with much vigour. His dicta are, however, so frequently at variance with accepted ideas that he cannot hope to gain the confidence of more conventional meteorologists. If the formation of cloud and the production of rain are not associated with the ascent of air, our faith is indeed vain. It came out in the discussion that it was largely due to the

publication of M. Guilbert's rules, which turn on the relation of wind to pressure gradient, that the notion of the "gradient-wind," was introduced into English meteorology. If on that account alone he is entitled to our gratitude.

The subjects for discussion for the two meetings in March, will be :—

March 2nd, 1925. *Wellen und Wirbel an einer quasistationären Grenzfläche über Europa.* By T. Bergeron and G. Swoboda. (Veröff Geophys. Inst., Leipzig, 2 Ser., Bd. III., H. 2). *Opener*—Major A. H. R. Goldie.

March 16th, 1925. *Diagnostic and prognostic application of mountain observations.* By J. Bjerknes. (Geofys. Pub., Christiania, Vol. III., No. 6). *Opener*—Mr. F J. W. Whipple.

Royal Meteorological Society

THE Annual General Meeting of this Society was held on Wednesday, January 21st, at 49, Cromwell Road, South Kensington, Capt. C. J. P. Cave, M.A., President, in the Chair. The Report of the Council for 1924 was read and adopted, and the Council for 1925 duly elected.

At the ordinary meeting which immediately preceded the Annual General Meeting, vacancies in the list of Honorary Members of the Society were filled by the election of the following distinguished foreign meteorologists :—

Dr. C. G. Abbot, Director, Mount Wilson Observatory.
Dr. W. van Bemmelen.
Dr. E. van Everdingen, Director, Netherlands Meteorological Service; President, International Meteorological Committee.
Dr. F. Exner, Director, Austrian Meteorological Service.
Prof T. Okada, Director, Central Meteorological Observatory, Tokio.
Dr. A. Wallén, Director, Swedish Meteorological Service.

A year ago the establishment of the Buchan Prize to commemorate the incorporation of the Scottish Meteorological Society with the Royal Meteorological Society was announced. The first award of the prize is to Mr. W. H. Dines. It is given for papers, principally on radiation, published recently in the *Quarterly Journal.* Mr. W. H. Dines was debarred by the state of his health from attending the meeting, and the certificate of the award was handed by the President to Mr. J. S. Dines on behalf of his father. Mr. W. H. Dines has been a pioneer in several branches of meteorology. His name is familiar to all meteorologists in connection with anemometry and with upper air research. It may well be that his work on radiation will be equally far-reaching. It was interesting to learn that Mr. Dines

was in touch with Dr. Buchan when the equipment of the Ben Nevis Observatory was under discussion, and also that Mr. Dines, as President of the Society, had given the first Symons Medal to Dr. Buchan.

In his Presidential Address, Mr. Cave covered a wide range. He laid most stress on the need for more general meteorological education. He urged that the best way to convince the public of the possibilities of modern forecasting was the prompt circulation of forecasts, and asked for the broadcasting of forecasts, not only in the evening but also in the morning and early afternoon.

Correspondence

To the Editor, *The Meteorological Magazine*

A Roof for the Campbell-Stokes Sunshine Recorder

In connection with Capt. Johnson's* letter and illustrations of the means adopted for protecting the sunshine recorder from hoar frost, perhaps your readers may be interested in the method that has been adopted here since 1921. After sunset or even later (at the 21 h. observation) when frost seems likely to occur, a cup or "hood" made of chamois leather and drawn with elastic at the opening is placed over the lens and fits snugly over the entire bowl as well. As additional protection a thick, brown paper bag is placed inverted over the whole instrument, and, except in the severest gusts, the ball is kept free from hoar frost. A coating of glycerine smeared on the outside of the bag tends to prevent the frost penetrating the paper. Hood and bag are removed before sunrise the following morning.

When frost has to be removed from the ball, it is generally found that as fast as it is thawed by one's hands, it congeals again. To obviate this, a little methylated spirit or petrol or some other quickly drying liquid should be poured on the lens. This greatly assists the melted hoar frost to dry off.

F. J. PARSONS.

The Observatory, Ross-on-Wye. January 2nd, 1925.

Notes on the Fog of January 10th-12th, 1925

APROPOS of the detailed discussion of the great fog of December 10th-11th, 1924, I should like to record a few observations upon the similar occurrence a month later. I spent many hours on January 11th wandering about the north-western suburbs and also central London, noting the distribution and character of the fog, and verified the following observations repeatedly. In the densely-built streets of central London, *e.g.*, Oxford Street,

* See *Meteorological Magazine*, vol. 59, December, 1924, p. 260.

Regent Street, the Strand and Fleet Street, the fog took the form of a dark, pungent, unsaturated haze, leaving pavements and clothes perfectly dry, and causing little hindrance to traffic, the visibility being at least 50 yards. But in all open places, viz., the parks, squares, and Thames Embankment, there was dense saturated water-fog, taking the form of great rolling blankets, very wetting and impenetrable to vision, and completely paralyzing traffic. The contrast in this respect between Trafalgar Square and the adjacent Strand was remarkable. At Hampstead there was thick water-fog, very wet and also very dirty, with hoar-frost on grass and roads, but comparatively little rime on the trees. I do not think it is sufficiently realized that what paralyzes traffic in London is the white mist or water-fog, just as it does in the country and at sea, and that if it were not for the fact that, as a general rule, the real water-fog in central London is confined to the more open spaces, locomotion would hardly be possible at all in bad fogs. Of course, if the water-fog is darkened by smoke the effect is worse, just as fog by night renders locomotion far more difficult than a fog of the same density by day. My experience on January 11th confirms a long previous experience to the effect that central London's fogs are chiefly pungent, dry, smoke-clouds or hazes, which, though often causing the darkness of night, do not hold up street traffic except at places where condensation is actually going on, *e.g.*, the parks, which are invariably pools of water-fog. The consequence is that, if the smoke problem is once effectively solved, inner London will see far less fog than the suburbs or surrounding country where the conditions are more favourable to nocturnal radiation.

In frosty anticyclonic weather, no doubt the river may breed a certain amount of water-fog by the process of "hot water steaming," and I suspect that the dense wet blanket of vapour in which I became enveloped from time to time along the Victoria Embankment on January 11th had some such origin. The dry fog, or as I should personally prefer to call it, haze, on the other hand, which I experienced in the closely built Strand, near by, did not appear to drift at all like the rolling water fog.

Nocturnal radiation fogs seem often to commence as very thin patchy meadow mists, gradually growing horizontally and vertically as the cooling and mixing of the air proceed. It is instructive in this connection to note that on Saturday morning, January 10th, the fog only affected the lower parts of London, leaving Hampstead in sunshine, whereas on Sunday morning, it had increased in depth so as just to reach the summit of the Heath, whilst on Monday morning the summit was completely enveloped.

L. C. W. BONACINA.

27, *Tanza Road, Hampstead. January 30th*, 1925.

Mr. Bonacina's observations can be given an interpretation which differs in some respects from that set out in his letter. Where there is a great fog, it reaches to a considerable height, say 500 ft., over London. Over the top of the fog, there is clear sky and the radiation from the droplets in the upper surface cools them and promotes further condensation. The ground at the bottom of the fog may be warmer or colder than the fog. In the case of the December fog, the ground, at any rate at Kew Observatory, was warmer than the fog. So far from the fog being made by contact with the ground, it was actually being warmed and to a certain extent the droplets must have been evaporating. In the case reported by Mr. Bonacina, the ground on Hampstead Heath had been cooled by radiation before the arrival of the fog, and contact with the ground may have caused the deposit of some of the moisture as rime. In both cases, the fog persisted near the ground, though it was not being made there.

In the streets, on the other hand, the foggy air is warmed not only by contact with the outer walls of buildings, but by mixing with the air leaking out from warm rooms and with hot gases from chimneys. The result is that the water drops evaporate, and the air is dry. A circulation is set up between the ground and the top of the fog and the descending currents bring down their quota of smoke to keep the fog black.

As Mr. Bonacina suggests in his concluding remarks, there must be two processes at work in the early stages of fog formation. To begin with, the ground cools by radiation and the air is cooled by contact with the ground. Warmer air, drifting over this cool air and mixing with it, forms wisps of cloud. Directly these wisps are formed, they start cooling by radiation and, if circumstances are favourable, they become the nucleus of a fog.

F. J. W. W.

Eclipse Readings

I SEND the following observations for what they are worth :—

Time.	Dry Bulb.	Wet Bulb.	Grass.
14 h. 46 m.	44·9	42·8	45·1
15 h. 20 m.	43·7	42·0	39·2
15 h. 49 m.	42·3	41·0	33·4
16 h. 32 m.	39·1	38·1	29·3

Sunset by calculation, 16 h. 33 m.

Sky partially clear, but persistent cloud over the sun.

H. NOWELL FFARINGTON.

Worden, Leyland, Preston. January 28th, 1925.

Heavy Rain with High Barometer

ON January 26th, with a shallow depression over the western end the English Channel, and an anticyclone covering most of the British Isles, remarkably heavy rain was experienced in the south-west. The Meteorological Office reported 2 in. in 24 hours at Exmouth, and other high totals on coasts of Devon and Cornwall. At this station we had 0·79 in., with an east wind and barometer varying between 30·30 in. and 30·38 in. This is the most remarkable fall in conjunction with a high barometer that I have ever noticed. The maximum temperature on 26th was 38° F., and part of the precipitation fell as snow at 1,000 ft. and all of it in this form at 2,000 ft.

R. P. DANSEY.

Kentchurch Rectory, Hereford. January 28th, 1925.

Rainfall Records

I FULLY agree with the Editor of *British Rainfall* * that there is no advantage in publishing both daily and monthly records where two gauges are used, but I am still of opinion that it is very desirable to keep both. I cannot give a better example than that in the *Meteorological Magazine* for January—the rainfall at Ross (only 12 miles distant) is there given as 4·03 in., while mine was only 2·83 in. Had it not been that my record was verified by my monthly gauge, I might have questioned its accuracy.

SPENCER H. BICKHAM.

Underdown, Ledbury. February 3rd, 1925.

A Strong Leeside Eddy in the Lake District

I WAS on Red Pike on January 1st, 1925. Red Pike is 2,500 ft. high and is part of the ridge which separates Ennerdale from the Buttermere Valley. The next summit to the south-east is High Style. Between the shoulders of Red Pike and High Style, there is on the Buttermere side of the ridge a coombe containing a tarn, Bleabury Tarn. On this occasion the wind was from the west on the top of Red Pike, but 400 ft. lower in the coombe the wind was from the east, blowing back towards the ridge. On the top of the ridge, the wind was so strong we could hardly stand up against it. To estimate the speed of the wind in the coombe, I timed with the aid of one of my friends, the passage of spindrift along the tarn. It took 8 seconds for 180 yards, so the speed was about 47 miles an hour, even with no allowance for friction.

RICHARD W. HALL.

5, Morland Place, Cockermouth. January 9th, 1925.

* British Rainfall, 1923, p. x.

Typhoon at Hong Kong

WITH reference to the article in the *Meteorological Magazine* for August, 1924, on the Hong Kong typhoon of August 18th, 1923, I beg to inform you that the Dines Anemograph of this Observatory was calibrated to-day, with the following results :—

First Set.			Second Set.		
Velocity.		Correction to Dines.	Velocity.		Correction to Dines.
By Dines.	True.		By Dines.	True.	
miles.	miles.	miles.	miles.	miles.	miles.
11	8	—3	12	11	—1
26	22	—4	29	25	—4
41	37	—4	49	44	—5
62	57	—5	64	60	—4
77	72	—5	80	73	—7
107	104	—3	103	100	—3
122	118	—4	124	121	—3

J. J. CLAXTON.

Royal Observatory, Hong Kong, September 19th, 1925.

[It will be remembered that the highest gust during the passage of the typhoon in question was recorded as 130 miles an hour. The correction —3 indicated by Mr. Claxton's calibration reduces this to 127 m.p.h. It is still the highest wind speed ever recorded autographically. It may be presumed that the calibration was made according to Mr. Dines's formula * $W = \cdot 00073\ V^2$, in which W is the pressure difference measured in inches of water between the inside and outside of the float and V is the wind speed in miles per hour. Ed. *M.M.*]

Line Squall—January 31st, 1925

THE following is an account of the shortest and sharpest line squall I have witnessed here during the last nine years.

Steady wind of force 8, twenty minutes preceding squall, decreased to force 7 on commencement of rain, when pressure rose about 0·6 mb. Strongest gusts about 53 m.p.h., at 16 h. 10 m., when hail commenced; barometer then rising nearly 2 mb. abruptly. Hail was unusually transparent, more like frozen

* *Observer's Handbook*, 1919, p. 85.

rain. Temperature fell over 11° in rear of squall (48° F. to 37° F.).

The usual long roll of black cloud was in line, SW'W—NE'E. No evidence of precipitation at 15 h. 30 m.: only 40 minutes then elapsing during which the squall appeared and broke overhead.

Precipitation about 4 m.m.

M. W. BINNS.

Market Street, Lutterworth. February 1st, 1925.

NOTES AND QUERIES

Wind and Light Railways

OUR frontispiece illustrates the wreck of a train on the Owencarra viaduct in the north of Ireland, on January 31st, when 4 people lost their lives. The viaduct is on the railway which runs from Letterkenny to Burton Port, on the west coast of Donegal. The Owencarra glen, being nearly straight, and bearing south-west to north-east, the bridge is exposed to the force of gales from the south-west. On this occasion, there were gales all along the north coast of Ireland, but no independent evidence as to the strength of the wind which overturned the train, or, as to whether it was a steady wind or a squall, is available.

It is of interest to remember that there is another light railway in Ireland, in County Clare, where precautions are taken to avoid the risk of an overturned train. At Quilty, on this line, an anemograph is installed with a warning device by which a bell is rung when the wind exceeds 65 miles an hour. When this occurs, so much pig-iron is put into each railway carriage as ballast. When 85 miles per hour is reached, the trains have to stop running. Perhaps similar precautions are desirable on the Burton Port line.

A Plunge through a Line Squall

THE following account of the experiences of Pilot G. P. Olley in a line squall on December 31st, 1924, is published by the courtesy of Imperial Airways, Limited. Pilot Olley was flying a twin engine Handley Page from Paris to London with passengers and freight. He encountered the squall near Marden, a station on the railway from Ashford to Tonbridge, the straight line which is such a conspicuous feature of the map of Kent. We are informed that it is not unusual for pilots to fly through squall clouds, but it is exceptional for them to be carried up so quickly and so far in the rising current.

"On arriving near Marden at about 14h. 50m., I encountered a severe line squall, stretching as far as I could see W to E (or perhaps W by S to E by N), so I decided to go through and

underneath it. On entering the storm at about 400 ft. altitude, I found my machine gradually lifting, and throttled down my engine to obviate this, but without effect.

My machine continued to rise steadily. In the space of about a minute and a half I found myself at an altitude of about 2,800 ft. and came right out on top of the storm where I received a huge downward bump.

I then carried on above the storm which was about five miles in width. When in the storm and cloud, I kept the speed of my machine at a little above ordinary cruising speed. On entering the storm I encountered a heavy deluge of rain and hail, but after rising to about 1,800 feet this ceased. The highest parts of the cloud were at about 4,000 ft.

G. P. OLLEY, Pilot."

The circumstances of the line-squall were somewhat unusual. Throughout the day, December 31st, there were west winds across England. The conditions were typical of polar air with squally showers of rain, hail, sleet and snow and local thunderstorms. Pronounced line-squall phenomena were limited to a relatively small area. A curious feature was that this particular squall occurred slightly behind the trough of low pressure, the barometer having risen for over an hour previously. The squall did not much exceed 50 miles in length. At South Farnborough, a large mass of false cirrus up to an estimated height of fully 15,000 ft. was visible for over an hour before and after the passage of the squall, and there was a display of mammato-cumulus on the lower rear portion of the " anvil," unusually well developed for the time of year. As the squall crossed London, the bearing of the front was from SW to NE. South Kensington (where the first drop of temperature was 9° F.) was passed at 13h. 36m., Croydon at 13h. 50m. At Shoeburyness at 14h. 40m, an extreme velocity of 73 miles an hour was shown by the anemometer.

It would seem that the cloud front wheeled to the right about this time, as it was almost facing south when Pilot Olley encountered it, at 14h. 50m. This change of direction is consistent with the fact that the squall reached Lympne, 24 miles ESE of Marden, at 14h. 55m. There was no rain at Lympne and the fall of temperature was only 3° F. The report that the top of the cloud was only 4,000 ft. up, suggests that the squall was on a much smaller scale at Marden than it had been at South Farnborough. This makes the strength of the upward current, at least 40 ft. per second, all the more remarkable.

Any additional information, either from autographic records or from weather diaries or the personal recollections of observers, would be valued by the Meteorological Office.

The Gales at the end of 1924

THE recent gales produced abnormally high tides at Calshot (at the mouth of Southampton Water). On November 27th, the meteorological station, 9 ft. above Ordnance datum, was flooded to the depth of a foot, the water being 4 ft. above the normal level for spring tides. The gale and high tide caused considerable damage in the neighbourhood, telephonic communication around Southampton being interrupted and the sea wall destroyed in several places. At 3h. a gust of 68 m.p.h. occurred—the highest since records have been available at Calshot. During the afternoon the wind abated in a very regular manner, becoming practically calm at 18h. A month later (December 27th) a similar gale occurred, but the enclosure escaped being flooded to the same extent. As an indication of the squally weather at the end of 1924 it may be mentioned that from January 1st, 1921, to November 26th, 1924, the total number of gusts recorded which exceeded 54 m.p.h. was 200, whilst from November 27th, 1924, to January 4th, 1925, there were approximately 400.

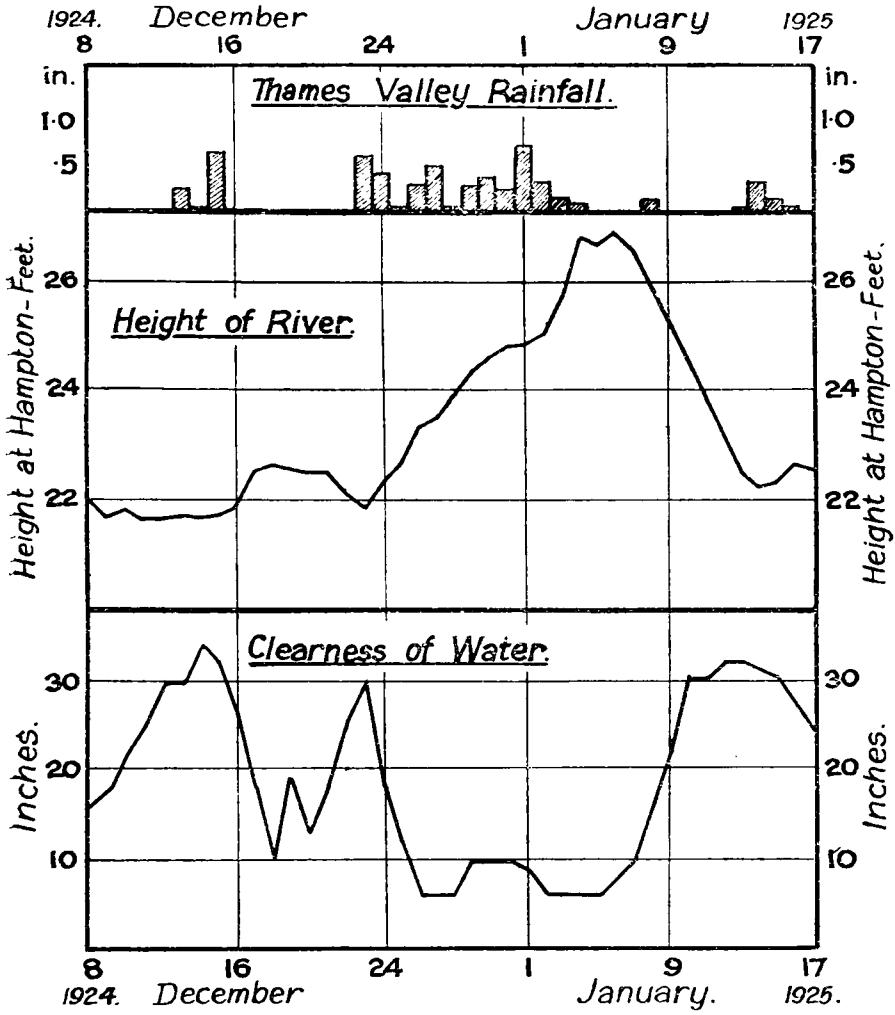
The Floods in the Thames Valley

THE persistent rain at the end of December, 1924, and in January, 1925, led to serious floods in many parts of England; notably in the Thames Valley. By the courtesy of Dr. Houston, of the Metropolitan Water Board, we are able to show in the accompanying diagram the fluctuations in the height of the river during the period from December 8th to January 17th. For comparison, the rainfall for each day averaged over the whole of the Thames Valley is also shown. It will be seen that after heavy rain on December 15th the river rose about 18 in., but it was at the normal winter level when the wet spell began on December 23rd. From that day to January 6th there was a steady rise. It will be seen that the floods were due to the recurrence of rain before the run-off from the land to the river had time to get away to the sea. The fact that the rain came at the end of a wet year had not much to do with the matter. The only preliminary condition is that the ground is sufficiently wet for the rain which falls on the country-side to run off, instead of being absorbed.

According to Lord Desborough's report to the Thames Conservancy Board, the maximum flow of the Thames at Teddington Lock was $9{\cdot}4 \times 10^9$ gallons per day on January 4th. Since the basin above Teddington has an area of 3,800 square miles, 1 in. of rain produces 56×10^9 gallons, and it follows that the Thames in flood can dispose of ·17 in. in a day. At the normal level the flow is $4{\cdot}5 \times 10^9$ gallons, equivalent to ·08 in. a day. The rainfall of the period, December 23rd to January 13th, when the river

was rising and falling again, was equivalent to an average ·19 in. a day. It is clear that most of the rain was accounted for by the flow at Teddington.

The rate at which the river fell at Hampton serves as a rough index of the extent of the floods. The fall was about 8 in. a day,



and, in the absence of information, it is reasonable to assume that this was the rate up and down the river. The flow of $9{\cdot}4 \times 10^9$ gallons would dispose of 8 in. of water from an area 200 miles long and 2,000 ft. wide. Suppose that half the water coming down was fresh drainage from the land, and half from the floods, then the flooded area would have been 200 miles long and 1,000 ft. wide. This estimate is fairly consistent with the descriptions in the newspapers.

The Clearness of Thames Water after Floods

IN the diagram on *p.* 15, the variations in the clearness of the Thames Water are shown. The observations utilised are made at Staines. The measurement recorded is the depth at which a white circular disc about 6 in. in diameter disappears when lowered into the water. It will be seen that the water became more turbid whilst the floods were rising, but that a high standard of clearness was reached before they had subsided. The unusual clearness was conspicuous enough to attract attention as far down the river as Richmond. No doubt the water is cleared by the deposit of silt on the riverside meadows.

The Control of Fire-Damp by Atmospheric Pressure

IN a letter from Dr. J. R. Sutton, published in the *Meteorological Magazine* for October, 1924, it is stated that " the fact that fire damp in mines may be most dangerous when the barometer is low or rather falling, is of course well-known." Mr. H. Harries who has given much attention to such questions writes to point out that, according to Dr. Sutton's diagram, the maximum production of firedamp at Kimberley did not occur when the barometer was falling. The high correlation is as Dr. Sutton mentions earlier in his letter between the rate of issue of the gas and the pressure itself, it is not between the rate of issue and the rate of change of pressure. Dr. Sutton's remark would be justified, however, if accidents occur when the amount of firedamp is increasing, and are rare when it is decreasing. The human element in such questions should not be ignored. It must be added that Mr. Harries believes that the statistical evidence is against the hypothesis that accidents due to firedamp are more common in British coal mines when barometric pressure is low. He claims to have found the opposite principle the basis of successful forecasts of dangerous conditions.

The Sound of the Explosions at La Courtine

A preliminary report on the observations made on May 15th and May 23rd, when explosions were made at La Courtine in central France, has been published by M. Charles Maurain. On each of these occasions there was a zone of normal audibility, mostly to the north of La Courtine. Outside a wide zone of silence there were areas of abnormal audibility. On May 15th there were two such areas to the east and to the west. On May 23rd there seems to have been a continuous area to the east and south. The inner boundary of these areas of abnormal reception was about 180 kilometres from the source of sound. The apparent speed of the sound averaged about 290 metres per

second. This speed is in accordance with the hypothesis discussed in the *Meteorological Magazine* last April, according to which the sound waves return to earth after reaching the "empyrean," the warm region, which, according to Lindemann and Dobson, exists at 50 kilometres or more above the ground. The radius of the zone of abnormal audibility is smaller than that given by the hypothetical distribution of temperature, 322 kilometres. It may be that the transition to the empyrean is well below 50 kilometres, say, at 30 kilometres. M. Maurain says nothing of the empyrean in his note; he merely remarks that the relation of sound waves to the ground appears to depend on the distribution of wind and temperature.

F.J.W.W.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1924.

Unit: one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays).

Averages for Readings about time of Sunset.

		Oct.	Nov.	Dec.
Cloudless days:—				
Number of readings	n	7	4	9
Radiation from sky in zenith ...	π I	528	463	463
Total radiation from sky ...	J	565	495	499
Total radiation from horizontal black surface on earth ...	X	741	656	665
Net radiation from earth ...	X—J	176	161	166

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

Cloudless days:—				
Number of readings	n_0	6	2	5
Radiation from sky in zenith ...	πI_0	27	15	16
Total radiation from sky ...	J_0	33	17	23
Cloudy days:—				
Number of readings	n_1	6	5	2
Radiation from sky in zenith ...	πI_1	102	34	21
Total radiation from sky ...	J_1	81	27	17

Unit for I = gramme calorie per day per steradian per square centimetre.

Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

Acoustic Clouds

IN an article in *Nature*,* discussing the growing demand for the solution of acoustical problems which are beginning to affect our everyday life, and the lack of research work done in this subject since the war, Major Tucker says: "The ease with which these instruments (the Service sound locators for the detection and location of aeroplanes) can be used depends on the structure of the atmosphere in which, apart from the refraction due to the above causes, there are irregularities due to local temperature and humidity variations, and local whirls and eddies. These variations in the medium have all been grouped under the heading of 'acoustic clouds.'† Contrary to what might be expected, these acoustic clouds are most in evidence on a warm sunny day of good visibility, and are undoubtedly due to unequal heating from the sun's radiation. After sunset these clouds dissipate, and we get, not only good listening as regards range, but also greatly improved powers of finding direction. The blurred acoustical image becomes well defined. On the other hand, a uniform fog is acoustically clear and it is only on the fringes of the fog that sound absorption takes place. Experiments have recently been performed with aeroplanes in which some idea of the dimensions of the acoustic clouds has been deduced. These have been obtained by taking a photographic record of the sound obtained from an aeroplane in flight, and observing the periodicity of the sound fluctuations.

"One of the outcomes of the study of meteorological conditions has been the fixing of an 'acoustic sky-line' which, under adverse wind conditions, always lies above the visual skyline. A source of sound moving through the air may be observed to rise or set over the skyline, with a definiteness almost as complete as the rising and setting of the sun, and when the sound is below the skyline a kind of acoustic twilight is produced. At this stage sense of direction is lost, the sound is diffused, and only arrives at the observer or microphone by scattering."

Terrestrial Magnetism and Seismology at the Meteorological Office Observatories

WITH regard to a recently published article on terrestrial magnetism and seismology‡ Dr. Chree writes, that, in his opinion, the statement that the magnetic records for Kew Observatory "have been thoroughly discussed" requires some qualification. Two investigations making use of the magnetograms of past years

* Vol. 114, 1924, p. 689.

† See J. TYNDALL, "On the Atmosphere as a Vehicle of Sound," *London Phil. Trans. R. Soc.*, 1874, *p.* 183; and J. TYNDALL. *Sound*, 3rd Edition, ch. vii.

‡ *Meteorological Magazine*, Vol. 59, November, 1924, p. 242.

are in progress, and much useful work could still be done on the magnetograms of years prior to the electrification of trams and railways. Also, while considering the Lerwick Observatory a most valuable addition to existing sources of knowledge, Dr. Chree thinks that additional observatories in the Hebrides (or north-west Scotland) and in western Ireland would probably be of great value for the elucidation of the phenomena of magnetic storms.

Advantage may be taken of this opportunity to correct a misstatement as to the position of Eskdalemuir Observatory. The observatory is not 17 miles from the nearest railway line. It is 17 miles by road from the most accessible main line station, Lockerbie. The distance by road from the post town, Langholm, is 16 miles. The nearest railway station is actually Moffat, just over 9 miles across the moors. The railway between Beattock and Wamphray stations comes within 8½ miles.

Local Rainfall Associations

THE collection and publication of rainfall records by various local associations throughout the country does much to stimulate and maintain interest in the subject, and official meteorology is indebted to those enthusiasts who for many years have voluntarily co-operated in such work and placed the results of their labours at the disposal of the Meteorological Office. In the majority of such associations the bulk of the work falls upon the collector, whose enthusiasm ensures continuity so long as he is able to deal with the clerical and arithmetical work involved. Changes are about to take place in three such associations, each with a long history, but it is cause for satisfaction that in two cases the work will be carried on without a break.

The Croydon Natural History and Scientific Society has published each month rainfall and other meteorological records from upwards of 100 stations in Surrey and adjoining counties. These records have been carefully complied by Mr. F. Campbell-Bayard for 37 years. The publication involved a heavy financial burden on the Society, and, as Mr. Campbell-Bayard was beginning to feel the strain of his onerous task, it has been reluctantly decided that publication must cease. In order that no records may be lost, all the contributing observers have been asked to forward their results direct to the Meteorological Office in future.

The Mid-Wessex Rainfall Association loses an earnest and inspiring worker in the Rev. H. A. Boys. Mr. Boys's interest in local meteorology dates back for 60 years. His interest in the rainfall of Wessex was such that, on his removal from North Cadbury Rectory (Somerset) to St. Marybourne (Hampshire) some years ago, he voluntarily continued the collection of the records from a distance rather than allow the work to lapse.

He is compelled to relinquish it on account of his advanced age and failing sight, but is making arrangements for the work to be carried on.

The work of compiling the meteorological reports and tables for the Northamptonshire Natural History Society, has been carried out with conspicuous success since January, 1889, by Major C. A. Markham. He is succeeded by Mr. R. H. Primavesi, who undertook the duties during the Great War.

Keswick Diary of the Eighteenth Century

PRIOR to the introduction of organised schemes in the second half of the nineteenth century, the recording of the weather was dependent on the enthusiasm and industry of a few observers who at different periods and for varying lengths of time maintained continuous records of weather changes in their own districts. Some of these weather diaries have been preserved, the earliest known diary being one which was kept at Oxford by William Merle, Fellow of Merton College, from January 1337, to January 1344, now in the Bodleian Library.

The diary which is the subject of this note and for the loan of which we are indebted to Miss Marshall, was kept at Keswick, by Peter Crosthwaite during the period August 1787, to December 1795. There are nine manuscript volumes of foolscap size in excellent condition. The diary comprises observations of pressure, temperature, rainfall, humidity, wind direction and force, amount of sky covered with cloud, cloud height in yards together with notes of remarkable occurrences. The last volume contains a few remarks on the weather during each of the years 1796 to 1803. An interesting account of the diarist by his grandson, John Fisher Crosthwaite, is given in the Transactions of the Cumberland Association for the Advancement of Literature and Science, Part III.

Observations were taken three times a day, at the hours which we should now call, 7h., 12h., and 18h. in summer, and at 8h., 12h., and 16h. in winter. At the beginning of the diary, barometer readings are given in degrees and tenths which suggests that the instrument then in use may have had a lever which moved over a graduated dial. On April 1st, 1788, a new inch barometer was obtained, and at the same time a new Fahrenheit thermometer. About twelve days after this, the latter instrument was moved from its position indoors where it had hung at a distance of 15 feet from a fire, and mounted outside in the shade on the north side of the house. By a comparison with a new Hollin thermometer about five years later this instrument was found to read 3° F. too low, but the diarist continued to use it, and there is no evidence as to whether any correction was applied.

Wind direction is given to 32 points of the compass and force

is expressed on the scale 0-12, 0 indicating a calm, and 12 a hurricane. The number of hurricanes recorded seems rather excessive for a place like Keswick. A comparison of the number of days of gales during the 5 years, 1919-1923, with the number of days of hurricanes during the 5 years, 1791-1795, yielded the following results :—

	1791	1792	1793	1794	1795
No. of days of hurricanes ..	39	13	9	13	5
	1919	1920	1921	1922	1923
No. of days of gales ..	2	4	3	3	2*

The term " hurricane," has no doubt been used more in the sense of " gale," than in its modern sense. There is evidently no correspondence between the scale employed by Peter Crosthwaite and that adopted by Admiral Beaufort in 1805 for use at sea and now used at land stations such as Keswick.

Rainfall observations commenced on April 1st, 1788. The rain was collected at the time of the evening observation, weighed, and the weight converted into depth in inches, results being given to four places of decimals. The results for the period 1788-1792, were discussed by John Fisher Crosthwaite, grandson of the diarist, in an article in the Transactions of the Cumberland Association for the Advancement of Literature and Science, Part II,, entitled " The Rainfall of Keswick." Observations of cloud amount extend from January 20th, 1788, to the end of 1791, and the precision with which the results are stated is sometimes startling. Thus, on February 1st and 10th, the proportion of sky covered by cloud at 7 a.m., was estimated to have been $\frac{1}{1500}$ and $\frac{1998}{2000}$ respectively ! The height of the clouds above Derwent is given in yards and was probably estimated by reference to mountains, the heights of which were known. Observations of the humidity of the air which commenced on April 10th, 1788, ceased at the end of 1791.

Aurora was observed on 57 occasions, between August, 1787, and December, 1795. An interesting item is the note of April 21st, 1789, referring to an observation of Uranus discovered by (Sir) William Herschel on March 13th, 1781. The note runs as follows :—" At 10 last night saw for the first time with Dollands Glas the Georgium Sidus about $\frac{1}{2}$ a degree W. of Mars."

The diary includes phenological observations and intimate notes about affairs in the district. The following extract is of historical interest :—

> April 2nd, 1789. The greatest rejoicings that ever was known in Britain on account of the recovery of our very good King and the most sincere addresses to Him and our virtuous Queen on the same account.
>
> P.I.M.

* October missing

Review

Climatic Laws—A Summary of Climate. By S. S. Visher, Ph.D. (Chicago). Size $9\frac{1}{4} \times 6$, pp. 96. *Illus.* New York: John Wiley & Sons, Inc., & London: Chapman & Hall Ltd., 1924. 7s. 6d. net.

The variations of climate over the globe are so intricate that he who sets out to make serviceable and easily remembered generalizations deserves our gratitude. Dr. Visher has read widely, and has collected no less than ninety generalizations. He has, however, handicapped himself unduly, for he eschews all mathematical symbols. Moreover, there is only one little table in his book, the only maps are charts covering the whole world, and graphs occur only in a pair of diagrams to which there is no reference in the text.

As a sample of the quality of the work, we quote at random one of the shorter paragraphs.

" 59. *Atmospheric humidity, both absolute and relative, averages less at the earth's surface in windy areas than in calm areas, otherwise similar,* because in windy areas, the moistened lower layers of air are soon mixed with or replaced by drier air from above. Upward convection is the agent which does most to prevent the surface air from being excessively humid. As water vapour is lighter than the other constituents of the surface air, moist air is forced to rise and is replaced by heavier and drier air. The height to which it can ascend is limited by condensation and by gravity. An exception to this rule of decreased humidity with increased windiness often occurs in the centres of Highs, where, in spite of slight windiness, humidity is often relatively low because of descending air."

This paragraph is open to several criticisms. In the first place the " generalization " printed in italics is of little value without some guide to tell us how " otherwise similar " areas are to be identified. Within the confines of the British Isles the rule is for the windy areas to be the damp ones: no doubt that is because these areas are not " otherwise similar." Merely as a theoretical statement the generalization is open to the criticism that the greater efficiency of moving air in promoting evaporation is ignored. The next two sentences seem to imply that convection is due in the main to the fact that damp air is lighter than dry air at the same temperature. Is there any evidence that this slight difference is an effective cause of air movement at all? We know of none. The significance of the reference to gravity in the penultimate sentence of the quotation eludes us.

This may not be quite a fair average sample of the work, but when the reader has noted a few cases of loose writing he becomes sceptical about every statement. What is to be made of the

following generalization ? (p. 71): "*Local contrasts in the amount of rainfall are greater in tropical than in higher latitudes among topographically similar places, with the exception of the doldrums.*" The only evidence quoted in support of the generalization refers to the Hawaiian islands. In what way conditions are exceptional in the doldrums is not stated or even hinted. Perhaps the most elusive remark of all is with regard to air pressure (p. 85): "At 5,000 feet there are appreciable effects on some climatic elements, especially upon the rate of cooling in the shade, and some people are made nervous." Are these good people nervous because they cool too quickly or for some more occult reason ?

The great merit of a book like this is that it encourages the spirit of enquiry : any of the generalizations might be chosen as the subject for a thesis and the search for the statistical and physical justification would in every case be a valuable exercise for the student of climatology. We hope that Dr. Visher will receive many such theses, and use them in the preparation of a second edition of his book.

News in Brief

THE Fourth Annual Dinner of the Meteorological Office Staff at Shoeburyness, was held at the Queen's Hotel, Westcliff, on Saturday, January 17th, 1925. The guest of the evening was Capt. D. Brunt, Superintendent of Army Services. An excellent entertainment by members of the staff followed the dinner.

The Weather of January, 1925

SOUTH to south-westerly winds and a temperature well above the average were the main characteristics of the weather of January. During the first few days there was a continuance of the rough weather which prevailed towards the end of December, and gales were experienced in many parts of the country. In some districts the average wind velocity reached about 60 m.p.h. (Beaufort force 10), while 80 m.p.h. was attained in gusts at Weaver Point on the 1st, and Southport on the 2nd. Heavy rain occurred locally during these first two days, the heaviest falls being in Wales and Westmoreland, where 99 mm. (3·90 in.) occurred at Blænau Brecon on the 2nd, and 51 mm. (2·00 in.) at Orton (Westmoreland) on the 1st. "Snow lying" was recorded in Scotland and northern England during the first week, a depth of 5½ in. being registered at Balmoral on the 3rd. In the rear of a secondary depression which crossed the British Isles on the 3rd and 4th, a ridge of high pressure spread northwards to Iceland from the Azores anticyclone, and a period of fairer, colder weather set in which, except for the passage of a

V-shaped depression causing rain generally, lasted nearly a week. Six or seven hours of bright sunshine were experienced on several occasions and some low minimum temperatures were recorded. By the 10th, the western districts of Ireland and Scotland came under the influence of depressions passing north-eastwards across the Atlantic. Anticyclonic conditions, however, still persisted in the south-east, and dense fog prevailed over a wide area in and around London from the 10th to 12th. On the 11th, temperature did not rise above 32° F. at several stations. By the 13th, mild conditions with strong south-westerly and local rain had spread over the whole country. Gusts of more than 70 m.p.h. were recorded in some parts, the highest one (95 m.p.h.) occurring at Lerwick on the 14th. Rainfall amounted to nearly 50 mm. (2 in.) at many places in Ireland. Between the 15th and 22nd there was a change to sunny, drier conditions, with local mist and fog, but after the 22nd the weather again became unsettled and there was much rain, especially in south-west England, on the 25th and 26th *e.g.*, 48 mm. (1·88 in.) fell at Ippleden, Devon, on the 25th), and in the north of England on the 29th and 30th. Snow occurred in parts of Scotland, and also in Ireland and north England on the 31st. On the 29th to 31st gales were experienced at several places. The rainfall for the month varied generally from about 75 per cent. of the normal to 150 per cent., but at Ashburton (Devon) and at Brighton there was more than twice the normal, while at Beccles there was only half the normal.

On the average, pressure was much above normal over central and southern Europe and the Mediterranean, the excess being 14 mb. at Nice, 10 mb. in Switzerland, and 5 mb. in the south of Sweden. In the north, pressure was below normal, the deficit being 7 mb. over Iceland, 8 mb. in the north of Sweden, and 13 mb. at Spitzbergen. The pressure distribution favoured warm south-westerly winds, and the temperature was abnormally high ; at Haparanda, on the Gulf of Bothnia, the mean temperature at 7h. (G.M.T.) was 28° F., as compared with the normal for January of 11° F. Rainfall was about normal in most parts of Europe. Generally unsettled weather prevailed during the first few days of the month, heavy rain fell in the Rhine Basin and floods were widespread there, but an anticyclone spread from the Atlantic on the 6th, and gradually extended over all central Europe, where it persisted until nearly the end of the month. During this period, fogs were reported from most districts : especially in France. The Mediterranean region enjoyed mainly fair weather until the last few days of the month. Some rather low temperatures were recorded, 21° F. at Milan on the 10th and 14th, and 25° F as far south as Colomb-Béchar in the Sahara on

the 14th. A report from Italy concerning the first ten days of January showed that the weather had been fairly favourable for the crops in all districts. On the other hand, there was a great shortage of water in Switzerland and Austria. Northern Europe was unaffected by the anticyclone and experienced some very stormy weather. Rainfall in southern Sweden was about 40 per cent. above normal, the weather being generally favourable for agriculture.

Reports from Persia show that there has been heavy rain in Kain and Seistan, and an expedition from Guinea (West Africa) to Lake Chad was also greatly hampered by floods.

Canada and the United States still suffered from intense cold and widespread snowstorms. At White River (Ontario), air temperature went down to —48° F. on the 14th, at Doucet (Quebec), it was —52° F. on the 19th and —54° F. on the 27th, and at Canton —42° F. on the 28th. Newfoundland had exceptionally stormy weather. The St. Lawrence River froze for a stretch of 100 miles from Lake Ontario. A severe snowstorm swept across the N.E. United States on the 30th.

A tropical cyclone passed over the northern part of western Australia on the 25th, doing much damage, especially to the town of Melbourne. The rainfall was slightly above normal for the month in Western Australia, Victoria, and New South Wales, but elsewhere it was above normal.

Mr. Mossman writes me that in Buenos Aires, the most severe drought on record was brought to an end by a violent thunderstorm on the 12th, during which 121 mm. of rain fell in seven hours, the streets were flooded, and much damage done. From September 15th, 1924, to January 11th, 1925, only the total fall was 84 mm., December was remarkably warm, and in the first eleven days of January, the mean daily maximum was 92·8° F. (8·1° F. above normal) and the maximum exceeded 103° on the 6th.

The special message from Brazil states that the rainfall was scanty in the central regions, being 95 mm. below the normal for January, and irregular though mostly below the normal in the southern regions. Depressions passed across the country more frequently than in the preceding months, and the areas of high pressure were unusually far to the south. Crops are generally in good condition. At Rio de Janeiro, pressure was 1·5 mb. above the normal, and temperature 0·5° F. below normal.

Rainfall January, 1925—General Distribution

England and Wales ..	107	per cent. of the average 1881-1915.
Scotland	106	
Ireland	114	
British Isles	108	

Rainfall: January, 1925: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square.....	2·01	51	108	*War.*	Birmingham, Edgbaston	2·12	54	105
Sur .	Reigate, Hartswood...	3·13	79	139	*Leics*	Thornton Reservoir ..	1·98	50	100
Kent.	Tenterden, View Tower	2·98	76	139	,, .	Belvoir Castle.....	2·05	52	116
,, .	Folkestone, Boro. San.	2·24	57	...	*Rut .*	Ridlington.....	1·54	39	...
,, .	Broadstairs, St Peter's	1·08	27	62	*Linc.*	Boston, Skirbeck	1·19	30	73
,, .	Sevenoaks, Speldhurst.	2·86	73	...	,, .	Lincoln, Sessions House	1·36	35	81
Sus .	Patching Farm.....	4·93	125	190	,, .	Skegness, Estate Office.	1·50	38	87
,, .	Brighton, Old Steyne .	5·39	137	229	,, .	Louth, Westgate	1·80	46	83
,, .	Tottingworth Park....	4·49	114	166	,, .	Brigg	1·60	41	89
Hants	Ventnor, Roy. Nat. Hos.	6·40	163	249	*Notts.*	Worksop, Hodsock....	1·74	44	98
,, .	Fordingbridge, Oaklnds	4·59	117	166	*Derby*	Mickleover, Clyde Ho..	2·27	58	112
,, .	Ovington Rectory	4·18	106	155	,, .	Buxton, Devon. Hos...	4·79	122	107
,, .	Sherborne, St. John Rec.	3·03	77	130	*Ches.*	Runcorn, Weston Pt...	1·93	49	81
Berks	Wellington College...	2·30	58	116	,, ..	Nantwich, Dorfold Hall	2·29	58	...
,,	Newbury, Greenham..	2·64	67	114	*Lancs*	Manchester, Whit. Pk.	2·05	52	82
Herts.	Bennington House....	1·57	40	86	,, ..	Stonyhurst College....	3·86	98	90
Bucks	High Wycombe	2·36	60	113	,, ..	Southport, Hesketh...	2·15	55	85
Oxf..	Oxford, Mag. College..	1·52	39	88	,, ..	Lancaster, Strathspey.	3·05	77	...
Nor .	Pitsford, Sedgebrook..	1·39	35	75	*Yorks*	Sedbergh, Akay	5·52	140	101
,, .	Eye, Northolm.....	0·86	22	...	,, .	Wath-upon-Dearne ...	1·76	45	92
Beds.	Woburn, Crawley Mill.	1·41	36	82	,, .	Bradford, Lister Pk...	4·27	108	148
Cam.	Cambridge, Bot. Gdns.	1·29	33	86	,, .	Wetherby, Ribston H..	1·97	50	96
Essex	Chelmsford, County Lab	1·45	37	95	,, .	Hull, Pearson Park ...	1·48	38	82
,, .	Lexden, Hill House...	1·14	29	...	,, .	Holme-on-Spalding ...	1·42	36	...
Suff .	Hawkedon Rectory ...	1·00	25	57	,, .	West Witton, Ivy Ho..	4·15	105	...
,, .	Haughley House.....	0·85	22	...	,, .	Felixkirk, Mt. St. John	1·61	41	81
Norf.	Beccles, Geldeston....	0·85	22	51	,, .	Pickering, Hungate ...	1·14	29	...
,, .	Norwich, Eaton	1·07	27	55	,, .	Scarborough.....	·	·	·
,, .	Blakeney	1·35	34	78	,, .	Middlesbrough	1·08	27	67
,, .	Swaffham	0·87	22	47	,, .	Baldersdale, Hury Res.	4·37	111	123
Wilts.	Devizes, Highclere....	2·68	68	123	*Durh.*	Ushaw College	1·68	43	82
,, .	Bishops Cannings	2·87	73	124	*Nor .*	Newcastle, Town Moor.	1·83	47	90
Dor .	Evershot, Melbury Ho.	4·78	121	138	,, .	Bellingham Manor....	2·86	73	...
,, .	Weymouth, Westham..	4·42	112	182	,, .	Lilburn Tower Gdns...	2·11	54	...
,, .	Shaftesbury, Abbey Ho.	3·24	82	125	*Cumb*	Geltsdale.....	3·11	79	...
Devon	Plymouth, The Hoe...	4·31	109	130	,, .	Carlisle, Scaleby Hall .	2·27	58	92
,, .	Polapit Tamar	4·30	109	116	,, .	Seathwaite	11·10	282	84
,, .	Ashburton, Druid Ho..	10·60	269	208	*Glam.*	Cardiff, Ely P. Stn.....	4·38	111	116
,, .	Cullompton	3·48	89	107	,, .	Treherbert, Tynywaun	10·70	272	...
,, .	Sidmouth, Sidmount ..	4·71	120	165	*Carm*	Carmarthen Friary....	3·68	93	84
,, .	Filleigh, Castle Hill ...	4·74	120	...	,, .	Llanwrda, Dolaucothy.	6·31	160	119
,, .	Barnstaple, N. Dev. Ath.	3·17	81	97	*Pemb*	Haverfordwest, School	3·56	90	77
Corn.	Redruth, Trewirgie ...	4·29	109	102	*Card.*	Gogerddan.....	4·08	104	100
,, .	Penzance, Morrab Gdn.	3·28	83	87	,, .	Cardigan, County Sch. .	3·59	91	...
,, .	St. Austell, Trevarna..	5·03	128	118	*Brec .*	Crickhowell, Talymaes	4·75	121	...
Soms	Chewton Mendip	4·81	122	125	*Rad .*	Birm. W. W. Tyrmynydd	7·03	179	112
,, .	Street, Hind Hayes ...	2·24	57	...	*Mont.*	Lake Vyrnwy	·	·	·
Glos..	Clifton College	3·23	82	114	*Denb.*	Llangynhafal	2·67	68	...
,, .	Cirencester	2·49	63	97	*Mer .*	Dolgelly, Bryntirion..	4·64	118	82
Here.	Ross, Birchlea	2·40	61	99	*Carn.*	Llandudno	2·04	52	79
,, .	Ledbury, Underdown.	1·99	51	90	,, .	Snowdon, L. Llydaw 9	12·05	306	...
Salop	Church Stretton.....	3·02	77	119	*Ang .*	Holyhead, Salt Island.	1·98	50	68
,, .	Shifnal, Hatton Grange	1·79	45	92	,, .	Lligwy	2·03	52	...
Staff.	Tean, The Heath Ho...	2·19	56	85	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	1 78	45	93		Douglas, Boro' Cem...	2·99	76	88
,, .	Blockley, Upton Wold.	1·56	40	66	*Guernsey*				
War.	Farnborough.....	1·59	40	74		St. Peter, Port Grange.	6·25	159	213

Rainfall: January, 1925: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Wigt.	Stoneykirk, Ardwell Ho	3·08	78	104	*Suth.*	Loch More, Achtary...	9·01	229	124
,, .	Pt. William, Monreith .	3·20	81	...	*Caith*	Wick	1·54	39	63
Kirk.	Carsphairn, Shiel.	9·90	251	...	*Ork .*	Pomona, Deerness	2·96	75	86
,, .	Dumfries, Cargen.....	4·44	113	111	*Shet .*	Lerwick	5·34	136	125
Dum	Drumlanrig	5·06	129	122	*Cork.*	Caheragh Rectory	6·44	164	...
Roxb	Branxholme	3·70	94	135	,, ..	Dunmanway Rectory.	7·49	190	120
Selk .	Ettrick Manse.....	8·24	209	...	,, ..	Ballinacurra	4·51	115	113
Berk.	Marchmont House	1·88	48	84	,, ..	Glanmire, Lota Lo. ...	5·79	147	135
Hadd	North Berwick Res....	1·37	35	80	*Kerry*	Valencia Obsy.	8·18	208	149
Midl	Edinburgh, Roy. Obs..	2·65	67	151	,, .	Gearahameen	14·80	376	...
Lan .	Biggar	4·76	121	179	,, .	Killarney Asylum.....	9·49	241	160
Ayr .	Kilmarnock, Agric. C..	3·73	95	109	,, .	Darrynane Abbey	5·82	148	116
,, .	Girvan, Pinmore.....	4·30	109	91	*Wat .*	Waterford, Brook Lo..	5·46	139	148
Renf.	Glasgow, Queen's Pk..	4·49	114	134	*Tip .*	Nenagh, Cas. Lough...	·		
,, .	Greenock, Prospect H..	6·68	170	98	,, .	Tipperary	6·90	175	...
Bute.	Rothesay, Ardencraig.	4·86	124	108	,, .	Cashel, Ballinamona ..	4·90	125	129
,, .	Dougarie Lodge	4·67	119	...	*Lim .*	Foynes, Coolnanes	6·04	153	160
Arg .	Ardgour House	10·48	266	...	,, .	Castleconnell Rec.	4·32	110	...
,, .	Manse of Glenorchy..	7·60	193	...	*Clare*	Inagh, Mount Callan ..	6·58	167	...
,, .	Oban	5·40	137	...	,, .	Broadford, Hurdlest'n.	5·16	131	...
,, .	Poltalloch	5·02	127	100	*Wexf*	Newtownbarry	·		
,, .	Inveraray Castle.....	7·74	197	94	,, .	Gorey, Courtown Ho...	4·24	108	136
,, .	Islay, Eallabus.....	4·37	111	93	*Kilk.*	Kilkenny Castle	4·59	117	143
,, .	Mull, Benmore	11·70	297	...	*Wic .*	Rathnew, Clonmannon	3·73	95	...
Kinr.	Loch Leven Sluice	3·79	96	120	*Carl .*	Hacketstown Rectory .	4·33	110	122
Perth	Loch Dhu	8·90	226	98	*QCo..*	Blandsfort House.....	4·00	102	122
,, ..	Balquhidder, Stronvar.	8·28	210	98	,,	Mountmellick	5·14	131	...
,, ..	Crieff, Strathearn Hyd.	4·21	107	104	*KCo.*	Birr Castle.....	3·30	84	117
,, ..	Blair Castle Gardens ..	3·60	91	108	*Dubl.*	Dublin, FitzWm. Sq...	2·39	61	104
,, .	Coupar Angus School..	2·66	68	112	,, .	Balbriggan, Ardgillan .	2·19	56	96
Forf.	Dundee, E. Necropolis.	2·01	51	103	*Me'th*	Drogheda, Mornington	2·23	57	...
,, .	Pearsie House.....	2·51	64	...	,, .	Kells, Headfort.....	3·65	93	116
,, .	Montrose, Sunnyside..	1·45	37	73	*W.M*	Mullingar, Belvedere .	3·30	84	103
Aber.	Braemar Bank	4·54	115	147	*Long*	Castle Forbes Gdns....	2·71	69	81
,, .	Logie Coldstone Sch. ..	2·50	63	113	*Gal .*	Tuam, Gardenfield ...	·		
,, .	Aberdeen, Cranford Ho	1·65	42	69	,, .	Ballynahinch Castle ..	5·66	144	...
,, .	Fyvie Castle	1·08	27	...	*Mayo*	Mallaranny.....	6·34	161	...
Mor .	Gordon Castle.....	1·32	33	65	,, .	Westport House.....	5·07	129	109
,,	Grantown-on-Spey....	2·85	72	118	,, .	Delphi Lodge	8·02	204	...
Na .	Nairn, Delnies.....	1·72	44	86	*Sligo*	Markree Obsy.	4·10	104	105
Inv..	Ben Alder Lodge	10·35	263	...	*Cav'n*	Belturbet, Cloverhill..	2·96	75	99
,, .	Kingussie, The Birches	4·15	105	...	*Ferm*	Enniskillen, Portora ..	4·02	102	...
,, .	Loch Quoich, Loan....	17·10	434	...	*Arm.*	Armagh Obsy.	2·21	56	88
,, .	Glenquoich	16·26	413	118	*Down*	Warrenpoint	2·59	66	...
,, .	Inverness, Culduthel R.	3·16	80	...	,, .	Seaforde	4·19	106	133
,, .	Arisaig, Faire-na-Squir	6·74	171	...	,, .	Donaghadee	2·40	61	95
,, .	Fort William.....	10·38	264	108	,, .	Banbridge, Milltown .	2·10	53	94
,, .	Skye, Dunvegan.....	5·48	139	...	*Antr.*	Belfast, Cavehill Rd. .	3·25	83	...
,, .	Barra, Castlebay	2·76	70	...	,, .	Glenarm Castle.....	3·63	92	...
R&C	Alness, Ardross Cas. ..	4·65	118	122	,, .	Ballymena, Harryville	3·17	81	85
,, .	Ullapool.....	6·00	152	...	*Lon .*	Londonderry, Creggan	4·04	103	112
,, .	Torridon, Bendamph..	10·17	258	108	*Tyr .*	Donaghmore	3·68	93	...
,, .	Achnashellach	8·37	213	...	,, .	Omagh, Edenfel	4·03	102	114
,, .	Stornoway	5·82	148	113	*Don .*	Malin Head	3·11	79	119
Suth.	Lairg	2·81	71	...	,, .	Rathmullen.....	3·61	92	...
,, .	Tongue Manse.....	4 35	111	110	,, .	Dunfanaghy	3·66	93	90
,, .	Melvich School.....	3·27	83	99	,, .	Killybegs, Rockmount.	4·48	114	80

Climatological Table for the British Empire, August, 1924

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1011·2	− 4·1	75	46	66·6	52·5	59·5	− 2·1	55·5	77	7·2	64	+ 7	21	4·7	33
Gibraltar	1015·3	− 1·4	91	64	81·2	68·4	74·8	− 1·2	67·5	70	3·6	2	− 1	2	...	...
Malta	1014·6	+ 0·2	96	67	84·3	73·0	78·7	+ 0·4	71·2	70	1·1	0	− 3	0	10·5	78
Sierra Leone	1014·3	+ 1·0	86	68	81·5	70·7	76·1	− 2·1	73·5	86	8·5	925	+ 23	28	...	...
Lagos, Nigeria	1012·1	− 1·5	87	71	83·2	74·3	78·7	+ 1·6	73·9	75	4·5	3	− 65	2	...	...
Kaduna, Nigeria	1016·9	+ 3·1	88	65	82·2	68·5	75·3	+ 1·4	70·2	89	1·1	442	+146	29	...	...
Zomba, Nyasaland	1017·4	+ 1·2	85	46	76·3	52·5	64·4	− 0·3	...	79	3·5	5	− 3	4	...	...
Salisbury, Rhodesia	1017·5	− 1·6	85	33	75·6	44·5	60·1	+ 0·2	49·9	49	0·9	0	− 2	0	...	...
Cape Town	1020·9	+ 0·7	77	38	63·2	47·4	55·3	+ 0·1	51·6	78	5·0	100	+ 13	10	...	...
Johannesburg	1022·2	0·0	75	28	63·3	42·0	52·7	− 1·2	41·0	55	1·6	4	− 5	2	9·8	88
Mauritius	1019·5	− 1·0	78	57	75·0	63·9	69·4	+ 0·9	64·6	78	6·7	109	+ 49	21	...	...
Bloemfontein	...	...	79	25	64·9	35·9	50·4	− 1·8	39·6	60	1·2	34	+ 22	2	...	...
Calcutta, Alipore Obsy.	1000·7	− 0·3	94	77	89·2	79·1	84·1	+ 1·1	79·7	89	9·1	385	+ 76	14*	...	...
Bombay	1004·6	− 1·1	89	75	85·4	78·4	81·9	+ 1·2	77·4	85	8·9	392	+ 32	14*	...	...
Madras	1004·6	− 0·9	102	76	95·3	78·9	87·1	+ 1·4	77·3	71	5·8	65	− 60	5*	...	...
Colombo, Ceylon	1008·9	0·0	87	73	85·6	77·3	81·5	0·0	77·4	74	8·2	115	+ 30	13	5·9	48
Hong Kong	1004·5	− 0·7	90	76	86·7	78·2	82·5	+ 0·4	77·6	82	6·7	271	− 94	16	7·3	57
Sandakan	...	...	91	73	88·5	75·0	81·7	− 0·2	76·7	78	...	169	− 36	13	...	...
Sydney	1018·9	+ 0·7	81	41	64·7	47·3	56·0	+ 1·0	50·3	67	4·0	58	− 20	11	6·5	60
Melbourne	1018·3	+ 0·2	70	35	58·5	44·1	51·3	+ 0·2	48·4	73	6·1	103	+ 57	14	4·3	40
Adelaide	1019·3	+ 0·1	75	39	63·9	46·3	55·1	+ 1·2	49·5	65	5·0	54	− 10	12	5·5	51
Perth, W. Australia	1019·1	+ 0·3	77	38	62·7	46·1	54·4	− 1·6	50·0	72	5·6	214	+ 71	16	5·5	50
Coolgardie	1018·3	− 1·0	82	33	66·5	41·3	53·9	+ 0·3	48·3	49	2·9	13	− 13	6	...	...
Brisbane	1019·8	+ 0·8	81	41	71·7	51·9	61·8	+ 1·2	57·6	68	4·1	34	− 22	12	7·2	65
Hobart, Tasmania	1013·6	0·0	64	36	56·6	41·7	49·1	+ 1·1	45·0	71	5·9	46	− 1	13	5·1	49
Wellington, N.Z.	1020·9	+ 6·2	61	31	55·0	44·8	49·9	+ 1·4	46·2	75	7·0	110	− 6	17	4·0	38
Suva, Fiji	1014·6	0·3	...	65	...	69·7	...	...	70·7	84	7·6	688	+479	23	...	...
Apia, Samoa	1010·5	− 1·7	86	71	84·9	74·5	79·7	+ 2·5	76·8	87	5·6	136	+ 42	20	8·2	71
Kingston, Jamaica	1013·1	− 0·4	93	70	90·2	73·6	81·9	+ 0·4	75·4	72	5·7	90	− 3	8	...	...
Grenada, W.I.	1013·3	0·7	88	70	85·3	75·3	80·3	+ 0·8	75·9	77	5·5	217	− 22	16	...	...
Toronto	1014·6	− 0·8	90	48	77·1	56·7	66·9	+ 0·3	61·1	75	4·2	100	+ 30	11	9·0	64
Winnipeg	1011·7	− 2·2	89	38	74·4	51·4	62·9	− 0·1	57·5	75	4·2	35	− 25	11	8·6	59
St. John, N.B.	1012·9	− 2·5	79	47	69·3	53·9	61·6	+ 1·0	57·4	84	6·4	170	+ 72	12	6·0	43
Victoria, B.C.	1016·9	− 0·3	71	46	64·8	50·9	57·9	− 2·2	53·7	80	4·0	13	− 4	2	9·2	64

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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Weather in Relation to Pressure Distribution, September, 1924 to February, 1925

By C. E. P. BROOKS, M.Sc.

THE autumn of 1924 and the winter of 1924 to 1925 have been characterised in the British Isles by a continuance of the wet weather of the summer. The monthly percentages of normal published in the *Meteorological Magazine* are as follows:—

	1924-1925.				
	Sept.	Oct.	Nov.	Dec.	Jan.
England and Wales ..	174	132	86	124	107
Scotland	173	97	68	125	106
Ireland	217	97	103	140	114
British Isles	183	115	85	127	108

The worst weather was experienced in Ireland and the best in Scotland; September and December, 1924, were months with outstanding amounts of rain.

In considering the relation of the weather to pressure distribution it was found* that during the three months, April to June, 1924, there was a broad belt with pressure below normal extending across the North Atlantic in about 50°N, crossing the British Isles and including Scandinavia and the Baltic, and that in July and August this belt was replaced by an area with pressure more than 5 mb. below normal, centred near Thorshavn and covering a large part of the British Isles. It has now to be stated that in September this type of pressure distribution reached its maximum intensity; pressure was 10 mb. below

**Meteorological Magazine*, vol. 59, September, 1924, p. 178.

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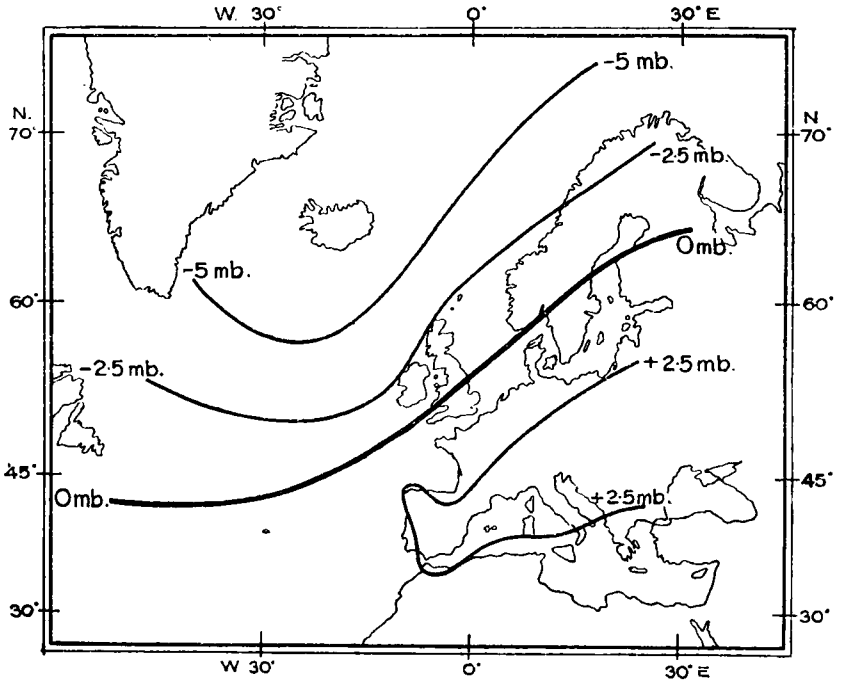
normal at Stornoway and more than 5 mb. below normal over the whole of the British Isles. After September the centre of pressure deficit moved slowly north-westwards; in October it lay over Iceland and in November probably over South Greenland. In the latter month the pressure over the North Sea was well above normal, giving England the first relatively dry month which it has enjoyed since March. In December, however, this pressure excess had moved away to central Europe, and the British Isles were again dominated by a deep low-pressure area



PRESSURE DEVIATIONS FROM NORMAL
AUGUST, 1924, TO JANUARY, 1925

over Iceland, the deficit at Seydisfjord being 18 mb. In January, 1925, the centre of deficit (—13 mb.) lay between Jan Mayen and Spitsbergen. In February the centre of greatest deficit had again moved south-west and lay over the North Sea, where pressure was nearly 15 mb. below normal. Pressure had at last become well above normal over the Azores, the excess being 10 mb. at Horta and 6 mb. in 50°N, 30°W.

Throughout the period pressure appears to have been relatively low over the North Atlantic west of the British Isles. The average conditions for the six months August, 1924, to January, 1925 (figure I.), show a deep trough of pressure below normal extending from Spitsbergen across Iceland to the oceanic region west of Ireland. During most of the period pressure remained

above normal over southern and central Europe. The normal pressure difference during August to January between Zürich in Switzerland and Reykjavik in Iceland is 15·6 mb.; during the period under review the difference was 26·1 mb. The pressure distribution was very favourable to persistently strong and stormy winds from between south and south-west, and these winds gave their character to the past six months.

In the article which has been referred to the belt of low pressure across the Atlantic in April to June was attributed chiefly to the reversal of the normal pressure gradient between Newfoundland and southern Greenland in January to March, which hindered the free outflow of the cold Labrador current. Pressure continued relatively low over Newfoundland, and high over Iceland until the end of June (map, page 180, September, 1924), thus tending to maintain low pressure over the British Isles until the end of September.

In explanation of the continuance of the low pressure over the North Atlantic through the winter it may be noted that one of the most striking anomalies of the pressure distribution of 1924 was the remarkably low pressure (10 mb. below normal) over the Azores during March and April.* Associated with the north-east trade wind there is usually a fall of pressure from the Azores to the coast of Africa. In March and April, pressure at Horta is normally 9 mb. above that at Sierra Leone, but in 1924 it was 1 mb. below, so that south-west winds must have replaced the north-east trade winds in this region. Now correlation of the trade-wind velocity (calculated from the pressure differences between the Azores, Gibraltar and Sierra Leone) with subsequent pressure in western Europe and the North Atlantic has shown that an abnormally weak or reversed trade wind is followed after the lapse of 6 to 9 months by low pressures in southern Greenland, Iceland, the Faroes and northern Norway, and by high pressures in the Azores. The sequence of events is that the reduction in the strength of the trade winds is accompanied by a reduction in the drift of warm water into the Caribbean Sea and north-eastwards in the Gulf Stream, so that the surface waters of the Norway-Greenland Sea become cooler than usual and the contrast in temperature between the ocean near the Azores and near Spitsbergen is accentuated. On these lines we obtain a partial explanation of the anomalies of the pressure distribution from September, 1924, to January, 1925; only partial, for the trade wind effect is probably not sufficient to account for the whole of the actual pressure deficit in the region between Greenland and Spitsbergen. Moreover, the course followed by the pressure isanomaly of —5 mb. suggests that there was abnormally high temperature and small ice-development in the East Greenland

*_Meteorological Magazine_, vol. 59, May, 1924, p. 79.

current and the temperature of this current would not be affected by the Gulf Stream. Thus in explanation of the pressure distribution that produced the wet spell from which we have suffered during the winter we have two factors, one of which has been traced back to its origin in the spring, when the trade wind circulation was weak ; the origin of the other, the supposed lack of ice in the East Greenland current, has not been connected with previous weather. It is important to notice that these factors, or at any rate the former, came into operation just as the effect of the inhibition of the Labrador current was dying away so that our south-westerly weather persisted with hardly a break.

OFFICIAL NOTICE

A new division of the Meteorological Office, the Airships Meteorology Division, has been formed to carry out meteorological work in connection with Imperial Airship routes. Mr. M. A. Giblett, assistant superintendent of the Forecast Division, has been promoted acting superintendent in charge of the new division.

OFFICIAL PUBLICATIONS

The following publications have recently been issued :—

Hygrometric Tables for the computation of Relative Humidity, Vapour Pressure and Dew Point from readings of Dry and Wet Bulb Thermometers exposed in Stevenson Screens (No. 265).

These tables, which have been computed on the basis of Regnault's moderate wind formula, have been prepared by the Meteorological Office, and will be brought into use for the preparation of data for publication as from January 1st, 1926. The tables are arranged for temperatures in Fahrenheit degrees, and vapour pressures in millibars, and they have been computed for a mean atmospheric pressure of 1,000 millibars. They are conveniently arranged to give in one " opening " the relative humidities, the vapour pressures and the dew points corresponding with a given range of temperatures of the dry bulb and of " depressions of the wet bulb."

PROFESSIONAL NOTES.

No. 38. *The Measurement of Upper Wind Velocities by Observations of Artificial Clouds.* By C. D. Stewart, B.Sc. (No. 245r).

This paper gives the theory and practical details of the method

of obtaining upper wind velocities from observations of artificial clouds. A tracing of the apparent path of a cloud is made in ink on the surface of a mirror and from the length of the trace the wind velocity, at the height of the cloud is computed by the use of a table of factors given in the text. The method was first used with shell bursts during the war, but the paper describes how it has been extended to include observations of clouds discharged from aeroplanes. Tables are given to enable the pilot to correct his height for any readings of his altimeter and thermometer. The method is extremely simple in use.

No. 39. *The Upper Air Circulation of the Atlantic Ocean.* By E. W. Barlow, B.Sc. (No. 245s).

Part I. of this paper gives an historical account of the various series of observations of temperature, humidity and upper wind currents made over the Atlantic Ocean chiefly by means of kites and pilot balloons. In Part II. the present state of our knowledge of the air circulations over the ocean is set out, and the relation of the trade winds, the counter-trades, and the eastern equatorial current is shown. Part III. deals with the meteorological aspects of Atlantic flying, including the frequency of sea-fog and of the conditions which create " bumpiness."

Discussions at the Meteorological Office

March 2nd, 1925. *Wellen und Wirbel an einer quasistationären Grenzfläche über Europa.* By T. Bergeron and G. Swoboda. (Veröff Geophys. Inst., Leipzig, 2 Ser., Bd. III., H. 2). *Opener*—Major A. H. R. Goldie.

In this paper the authors have made a close study of all the available observations for 6 days and have traced the oscillations of the boundary between a warm and cold current of air flowing side by side from the Atlantic to Central Europe. These oscillations were manifested as secondaries to a large cyclone which itself was drifting eastwards. The last of the secondaries itself developed into a cyclone. The evidence is clear that the cyclone did originate from the pre-existing discontinuity in the airflow. Until recently many meteorologists were inclined to look for the cause of cyclones in the behaviour of the upper currents ; such cases as this demonstrate that the causes are nearer at hand. A difficult paper but very important.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, February 18th, at 49, Cromwell Road, South Kensington,

Capt. C. J. P. Cave, M.A., President, in the Chair.

Dr. Th. Hesselberg, Director of the Norwegian Meteorological Service, and Prof. J. Maurer, Director of the Swiss Meteorological Service, were elected Honorary Members of the Society.

L. D. Sawyer, B.A.—The Effect of Pressure Distribution upon London's Sunshine in Winter.

The amount of sunshine in London is determined partly by meteorological conditions, partly by the fouling of the atmosphere by smoke. In this paper, South Farnborough, some 30 miles to the southwest, is taken as the "control" station with a comparatively clean atmosphere. It is found that SE winds give South Farnborough about 4 hours sunshine a day in winter, whilst NE winds are the worst with only $\frac{3}{4}$ hr. The SE wind is cold and dry and has come for a great distance over land. The NE wind on the other hand has picked up moisture in its passage over the North Sea and it brings to London a uniform canopy of cloud. (It is also a smoky wind at South Farnborough, so that the records at the control station must be adversely affected to a certain extent). Whatever the wind direction, smoke deprives the average London station of a third of its sunshine, *i.e.*, the heating power of the sunshine is so far reduced that the number of hours during which a sunshine card is scorched is cut down by one third. The central stations and those to leeward for the particular wind lose a half, whilst the windward stations are not affected by the smoke. Miss Sawyer's investigations cover only five recent winters. The desirability of working up earlier records was brought out in the discussion. There has probably been a considerable improvement in the period which has elapsed since the sunshine recorders were set up about 1880.

Prof. S. Chapman, F.R.S.—On the Changes of Temperature in the Lower Atmosphere, by Eddy Conduction and otherwise.

It has long been recognised that the daily variation of temperature is due in the main to the heating of the atmosphere by the ground. The process is not completely understood, however. The temperature records which are kept at various heights on the Eiffel Tower provide material for investigating the flow of heat from one level to another. The material has been utilised by G. I. Taylor and by W. Schmidt. Professor Chapman is not satisfied that the results obtained by these workers tell the whole story and he has made a closer analysis of the statistics. He finds that "eddy conductivity," the only agency considered by Taylor, will only account for half the heat which reaches the upper levels. The conclusion is that radiation plays a more important part than had been suspected. It was urged in the discussion that the methods adopted in the paper did not take

account of convection. However that may be, it is clear that there is room for further study of the familiar phenomena of the daily temperature change. Meteorologists have reason to regret that the Watkin Tower which was started at Wembley some forty years ago was never completed to give us English observations comparable with the French ones. It was, therefore, interesting to learn (in the discussion) that we are soon to have records which will serve the same purpose from instruments at the great wireless station at Leafield.

N. K. Johnson, M.Sc., and O. F. T. Roberts, B.A.—The Measurement of the Lapse Rate of Temperature by an Optical Method.

The refraction of light as it passes over cold or warm ground is a bugbear of surveyors. It was suggested in the *Meteorological Magazine* in 1920 that the phenomenon might be turned to good account as giving a measure of the variation of temperature with height. The authors of this paper set up scales at different distances from a telescope and observed how the apparent height of the graduations varied under different conditions. Their conclusion is that the "lapse-rate" of temperature can be determined with considerable accuracy, so that it will be possible to utilise the method in the study of the interchange of heat between ground and air, the problem of the preceding paper.

Correspondence

To the Editor, *The Meteorological Magazine*

Drought in Western Anatolia

FOR the past three months the western end of Asia Minor has been suffering conditions of drought. Local residents remember no such drought since 1890 but regular weather records in this region do not date back that far. Good rains invariably fall in the autumn, that is to say, about November. At this time of the year they are intermittent, but towards the end of December and during January and part of February they are practically continuous. March rains are intermittent and from the beginning of April they usually cease. A few heavy downpours may come between April and September but they are few and far between if they come at all. The "winter rains" are of especial importance to the farmers, for cereal crops are usually planted immediately after the first autumn rains and depend on the later rains for proper growing conditions. Tobacco and cotton crops are planted after the March rains, but depend upon a well-watered and prepared soil.

The table below gives (*a*) the average rainfall (1907-1912) for the rainy season according to the Admiralty and War Office

Handbook, I.D. 1117, on the Climate of the Eastern Mediterranean; (*b*) the average rainfall according to records kept at the International College, Smyrna, from 1902 to 1925; and (*c*) a record of the rainfall of 1924-25 rainy season, for comparison :—

	Sept. in.	Oct. in.	Nov. in.	Dec. in.	Jan. in	Feb. in.	Total. in.
(*a*) ...	0·52	0·81	3·36	3·72	2·79	2·61	13·81
(*b*) ...	0·31	1·81	3·67	4·37	4·28	3·05	17·49
(*c*) ...	0·0	1·78	2·15	0·01	0·00	1·10	5·04

To express the same statistics in another way, the table below states (*a*) the average number of rain-days in Smyrna, according to the Admiralty and War Office Handbook I.D., 1117, and (*b*) the record of this year's rainy season in rain-days :—

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Total.
(*a*) ...	2·5	3·0	10·3	11·1	10·8	10·6	48·3
(*b*) ...	0	9	7	1	0	7	24

The weather during this period was variable between extreme cold caused by bitter north-east winds during December and part of January, and unusual heat in the latter part of January and throughout February. At present the days are hot, the ground is baked, the streams are dry. Fruit prospects, especially raisins and figs, are discouraging, and the cereal crops will probably be complete failures. Agriculture generally will be seriously injured this year. Already plans are being laid for a famine relief campaign next summer; for the chronic wheat shortage will be severely accentuated by the failure of crops.

The drought reaches along the western coast to Cilicia and the Adana district, and influences the whole littoral lowlands. In the interior, however, in the mountainous table-lands, an unusually severe winter has been experienced with deep snows of several feet in depth.

KENNETH P. KIRKWOOD.

International College, Smyrna, Turkey. March 1st, 1925.

A Great Hailstorm, Windsor Park, March 1st, 1925

A thunderstorm by which I was detained nearly two hours at Virginia Water on the afternoon of March 1st was of extraordinary violence for so early a date, inasmuch as it was emphatically of the summer type—protracted, slow moving, with inky blackness and absence of wind. Cars coming from the direction of Sunningdale were laden with hail, and later in travelling by bus to Windsor, and thence by train to London, I passed through two strips of hail-stricken country, where it lay thick on the roads and fields, one at the edge of the Great Park, and another close to Slough. People called it "snow" but it was a genuine case, in the main at all events, of thunderstorm hail.

In the morning masses of cumulo-nimbus, some with " anvils," began to develop almost as soon as an early fog dispersed, but it was not until about 1 p.m. that I definitely noticed the nucleus of the coming storm, which appeared to grow, in part at least, *in situ*. I carefully verified that on the southern periphery of this nucleus low clouds were moving from the west, and on the northern periphery from the east, whilst on the east side they appeared to be drifting from south, though in this case I may possibly have been deceived by perspective. This suggests, in fact almost demonstrates, a distinct if weak cyclonic circulation round the growing storm centre. From this apposition between a westerly and an easterly current, and from previous experience of spring thunderstorms of this type being the precursor of a spell of bitter east wind, I felt almost sure that the wind over south-east England next day would be east, a prediction which was amply fulfilled.

There were evidently a combination of factors necessary for the production of this storm. In the first place we had polar air on March 1st with probably a very low upper air temperature ; in the second place the strengthening equinoctial sunshine was decidedly powerful in the forenoon and this must have engendered a steep lapse-rate ; and thirdly, perhaps the most important factor of all, there was the conflict of air currents associated with the change from a westerly to an easterly type of weather.

A thunderstorm of this violent type struck me as peculiarly impressive at a time of year when Windsor Forest was looking so bleak and bare.

L. C. W. BONACINA.

27, *Tanza Road, Hampstead, N.W.* 3. *March 4th*, 1925.

Localised Precipitation

FEBRUARY 13th and 14th furnished a notable example of the complex weather conditions that have prevailed throughout the month.

13th. After an overcast morning with sleet, the sky cleared gradually soon after 10h. and became perfectly clear. There was no wind. Late at night there were 12° of frost (on the grass). During the night rain set in.

14th. Overcast and wet ; then sleet ; no wind till 14h. when it began to blow strongly from the west ; from 16h. 30m. to 18h. 30m. a snowstorm ; sleet all night.

15th. Sleet with SSE wind ; 10h. 30m. rain with SW wind ; 14h. sky cleared in the south, rain ceased ; 16h. 15m. rain began again.

From Friday night, the 13th, till Sunday 15th, 2 p.m., precipitation never ceased. The barometer was very low the whole of the 3 days, falling on Saturday slightly—but rising on Sunday. On Sunday, the 15th, a young friend of mine came

here from Hexham on a bicycle. He had been in Newcastle on Saturday from 5 p.m. till midnight and it was quite fine. On Sunday he left Hexham about 9 a.m. with genial sunshine, dry roads and a light following SE breeze and had no thought of anything else till he ran into it about 12 miles from here. The last 10 miles he had ridden in soaking sleet, ploughing through inches of snow and slush.

A. J. DEXTER.

Falstone Rectory, Northumberland. March 2nd, 1925.

Rainfall of very Rare Intensity

I have been invited to write a criticism of the Article "On Rainfall of very Rare Intensity," compiled from official records by Mr. F. J. W. Whipple.* In so far as it contains the results of one instrumental and two estimated records, there is, of course, nothing to criticise, and in the considerations which I am now putting forward I have no desire to impugn the *bona fides* of anyone whose experiences may not have coincided with my own. My only desire is to contribute something to the solution of a problem which is admittedly of considerable practical importance, and one which it is no exaggeration to say has never been seriously studied. With regard to instrumental observations, it is somewhat surprising that Symons's Storm Gauge, if it was a success, has not continued in use. I know of no modern recording instrument which is not almost at once put out of action by really heavy rain, and it would appear that the Symons Gauge must have been open to further objections than those noted. From its construction the record cannot have been co-incident with the actual fall, for the rain is conducted away through a bent pipe into the vessel which contains the float, and the rise of the water in the vessel raises the float which actuates the mechanism. Now, unless this apparatus is kept at all times perfectly clean—a difficult matter in a dirty climate—the action of the float and its mechanism must tend to be jerky, and my suggestion is that a very great variation in the mean rate must be due to such a cause, if, which is by no means certain, the apparatus itself is in all respects well designed to record what it purports to record. The difficulty about apparatus of this sort is that it is only required to function on rare occasions, and it is almost impossible to ensure that it will function properly. The suggestion I put forward is that no apparatus has yet been designed, which is not "smothered" by heavy rain; this has certainly been my experience with all automatic recorders. If the Symons Storm Gauge was a success, why has it been relegated to a Museum?

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* *See Meteorological Magazine*, vol. 59, August, 1924.

And why cannot our modern designers give us a satisfactory Storm Gauge ?

Next as to the estimated records ; the report of the 2·90 in. in 30 minutes, admits enormous hailstones, which is hardly a fair criterion for rain. The total of 2·09 in. in 35 minutes is, of course, a heavy fall which was apparently unaccompanied by hail, but what is most surprising to me, with quite as many years' experience as an observer, is that anyone could venture to make such an estimate of the interim intensity, or that any such estimate should be accepted. With a greater experience of really intense rainfall than anyone whose observations have been confined to this country could hope to possess I say without hesitation that it is impossible to make an estimate of really intense rain with any approach to accuracy. I have proved instrumentally that the apparent intensity of rainfall is most deceptive, and I am willing to wager any observer who chooses to come forward that he will not estimate the next really heavy downpour within a wide margin, even as to the total fall.

I hope, in due course, to be allowed to bring forward certain negative evidence which establishes, in my submission, that there must be something very wrong with an estimate of a rate of 15 inches per hour for this country, and, as the evidence comes from an area of cyclonic storms far exceeding in intensity anything I have experienced in this country, it can only be open to the objection that it is not evidence relating to this country. I may say, in advance, that it is the result of several years observations especially directed to this question, and contains no estimates whatever.

F. J. VARLEY.

4, *Lansdowne Crescent, London, W.*11. *March 2nd*, 1925.

Types of Mammillated Clouds

SOME little time ago correspondence appeared in *Nature* regarding mammato-cumulus and its mode of formation. Mammillated clouds are seen rather frequently in Australia and especially, perhaps, at Melbourne. Two types of occurrence are noted. In the first the mammillation appears beneath a portion of the general cloud mass in front of the trough of a depression, the cloud being alto-cumulus or alto-stratus (about 2 km. to 5 km. high) approximating to nimbus. The second is in the unstable region in the rear of the trough of a depression and associated with the flanks or rear of cumulo-nimbus. In these cases, hail often falls from the cumulo-nimbus.

On two occasions, however, I have seen the mammato form developed in cirrus cloud and, as I have not seen this described elsewhere, it is perhaps worth recording. On the first occasion, November 30th, 1921, the mammillations appeared in two

separate masses of cirro-stratus seen low down and in profile. From the level strata of the cirro-stratus, the mammillations depended like inverted balloons and were the most symmetrical and perfect in shape of any I have seen. In colour they were the pale white typical of cirro-stratus. The cloud was moving from the west-south-west, and the region was in the rear of a depression.

On the second occasion, the mammillations were seen almost overhead, again in two masses of cirro-stratus, moving this time from the north-west. Being seen in plan and having the tenuity of cirrus cloud, they were much less striking than on the first occasion. Furthermore, they lasted for a minute or two only. The date was December 5th, 1924, and Melbourne was on the south-eastern side of a tropical depression. The temperature was high and rising and the insolation intense. Much of the cirro-stratus visible showed strongly developed cumuliform tops, and later in the day there were thundershowers and a change to southerly winds as the trough of the depression passed. It is suggested that a large scale uplift of the type characteristic of the centre of a depression caused rapid condensation at the cirrus level in a mass of air which had been brought to an unstable condition by surface heating over the continent: that, in consequence, precipitation took place: that the falling particles owing to their low temperature and through evaporation cooled the layers beneath the cloud which thereby became denser than their surroundings and commenced to fall. A similar explanation may frequently apply to the formation of mammato-cumulus. The dryness of the air in Australia probably accounts for the effect being visible so frequently, as under moister conditions it would be obscured by rain.

EDWARD KIDSON.

Meteorological Bureau, Melbourne. December 16th, 1924.

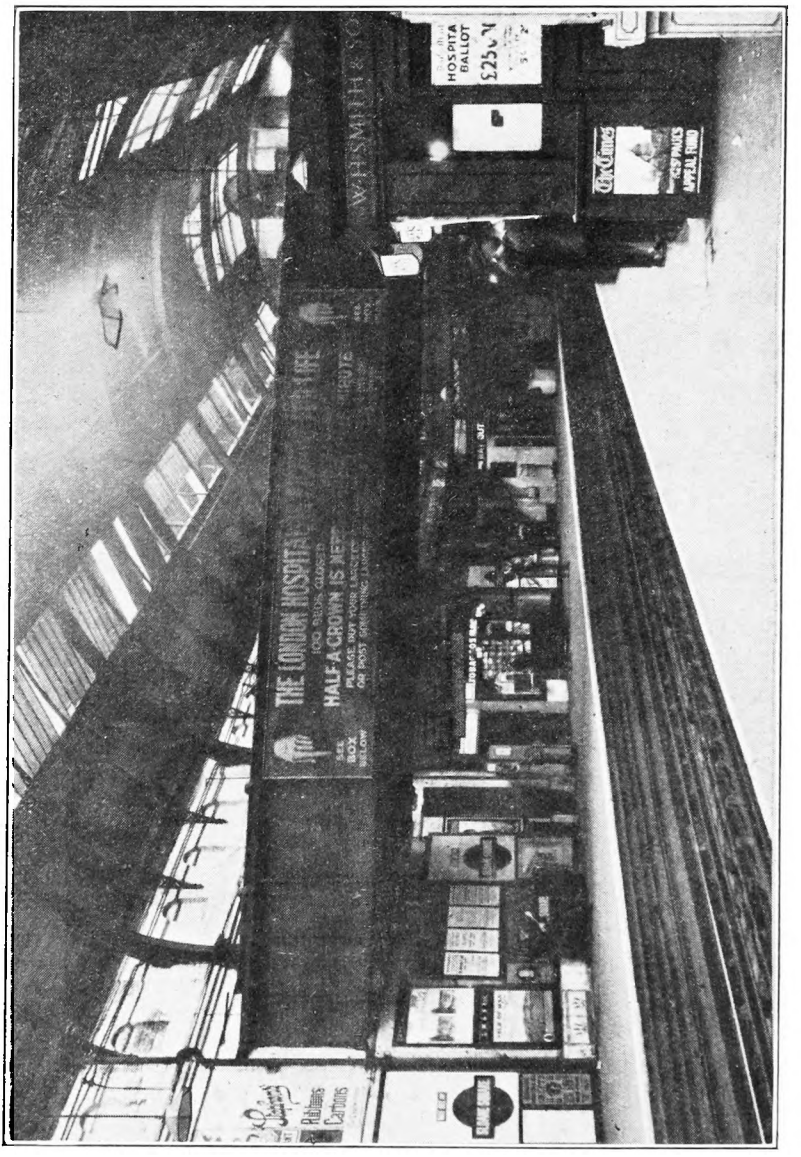
Lunar Rainbow and Eclipse

IT must be a rare occurrence for a Lunar Rainbow and an Eclipse to follow one another but such was the case here on February 8th. Though a westerly gale was blowing and small detached clouds raced across the sky the visibility was exceptionally good. On coming out of church at 19h. 30m. a lovely lunar rainbow was seen in the west, the colours being quite distinct. It was wonderfully stable and remained for at least an hour, waning away and then brightening again from time to time, and lasting, I believe, till the beginning of the eclipse, for which the conditions were ideal.

R. P. DANSEY.

Kentchurch Rectory, Hertford. February, 1925.

to face p. 41.



SLOANE SQUARE STATION

NOTES AND QUERIES

A Course of Training for Observers

IT is proposed to hold a third general course of training for meteorological observers at Kew Observatory, Richmond, Surrey, during the week April 27th to May 2nd, 1925, both dates inclusive, provided that a sufficient number of applications are received.

The subjects to be dealt with will include the following :—

Meteorological instruments and method of Observation.

Recording of Observations and their transmission to the Meteorological Office.

The Weather Map ; charting of observations distributed by wireless telegraph.

Climatology.

The course is addressed primarily to observers at stations which report regularly to the Meteorological Office. Others will, however, be admitted, at the discretion of the Director, as far as the accommodation permits. Applications for tickets of admission should be made to the Director, Meteorological Office, Air Ministry, Kingsway, W.C. 2. There will be no fee for the course.

The Lesson of the Grimy Bridge

LONDONERS are familiar with the little aqueduct which crosses Sloane Square Station and carries the outflow from the Serpentine. The aqueduct has an advertisement of the claims of the London Hospital on either side, and it is remarkable that one section of each advertisement has become grimy whilst the rest is comparatively clean. As will be seen from the photograph (which has been taken by the kind permission of the Metropolitan District Railway Company) the position in which the dirt occurs on the west side of the aqueduct is over the down line. The corresponding smear on the other side is over the up line. It is clearly suggested that as an electric train passes under a bridge the air pushed out of the way by the front of the train eddies back against the bridge. It might have been thought that the air carried along by friction in the direction of the train's motion would blow up against a bridge and leave its mark, but if this effect occurs at all, it is not so conspicuous as the other.

Is it superfluous to add that even apart from questions of aerodynamics the notices on the aqueduct deserve attention ?

The Rotor Ship

A NEW method for the propulsion of ships by wind has been invented by Herr Anton Flettner, and tried in Kiel Harbour. Use is made of the fact that when the wind blows past a cylinder which is rotating about a vertical axis, the resultant force has a large component at right angles to the wind. Flettner's boat has two rotating cylinders, drums 60 ft. high and 10 ft. in diameter and they are driven at 100 revolutions per minute by 9 horse-power motors. According to newspaper reports the trials have been successful, but whether an economical method of navigation will be evolved remains to be seen.

The principle of the experiment is well known: it explains the soaring flight of a golf ball. Professor V. Bjerknes has a pretty experiment in which the lash of a whip is given a few turns round a cardboard cylinder, the cylinder is placed on a table and flung forward by a jerk of the whip. The cylinder flies forwards, then upwards, and regains the starting point by a more or less circular course. Flettner's large scale illustration of this principle is of theoretical interest even if it never develops into a practical success.

Since the above note was written, the Buckau, which is propelled by the rotor system, has completed her voyage from Danzig to the Firth of Forth. During the first part of the journey, to Kiel, it was found impossible with a westerly head wind blowing to make more than 4 knots, but afterwards the speed increased to 7 knots.

The Meteorological Station at Jan Mayen

ONE of the familiar difficulties in the study of weather maps is lack of information about the precise nature of the surroundings of the stations. The exchange of such information was recommended by a resolution of the International Meteorological Conference at Utrecht, and many accounts have already reached the Meteorological Office. One of the most interesting is that for the Norwegian station on the lonely island, Jan Mayen. We learn that the island is dominated by a great mountain, Beerenberg, 8,300 ft. high. The summit is 9 miles to the north-east of the meteorological station, and the lower ridges afford shelter from winds from that side. It is found also that winds from the south-west, blowing towards the mountain, are reduced in strength as well as diverted. The observations of winds from south or from north-west can be relied on. It is mentioned that the cloud movements are at times so irregular that no direction of drift can be reported. The characteristic difficulty in the weather observations is the impossibility of distinguishing at times between snow falling from the clouds and snow brought

from the mountains by the wind. As to temperature, it is stated in the memorandum that with winds from the north the influence of the mountains ought to raise the temperature at the station by 2° to 4° F. It would be interesting to know on what observations this estimate is based.

A Device for Observing with the Theodolite at Night

IN the *Geographical Journal*, December, 1924, Mr. E. A. Reeves describes a device for sighting a theodolite at night without crosswires or field illumination. By the use of half-silvered glasses two images of a star are formed, and when the two images are brought into coincidence the observer knows that the star is on the principal axis of the telescope. The device might perhaps be adapted for use at night in observations of the lanterns carried by pilot balloons.

North and South Winds Cancel

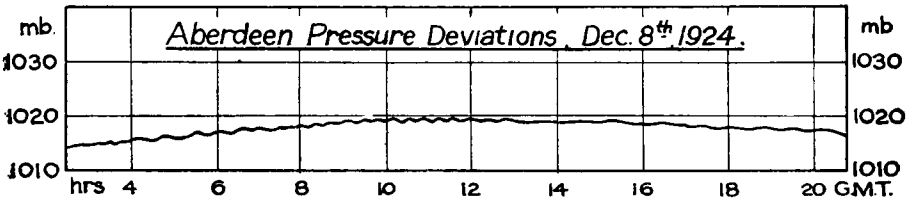
A sounding balloon sent up at Kew Observatory at 7h. 15m. (G.M.T.) on November 11th, 1924, fell at Woolwich Arsenal at 9h. 30m., having reached a height of 16·5 kilometers in the meantime. When the balloon left the Observatory it travelled towards the north-north-east, and when it was seen at Woolwich it was coming from the south. Clearly there must have been wind with a north component aloft. An almost exactly similar thing happened on December 4th, when a balloon sent up at Kew at 12h. 25m., fell in France after having reached about 14 kilometers. The run of the balloon in this case was 265 kilometers towards the south-east, and the pressure distribution almost exactly similar to that on the first occasion. A deep low south of Iceland and a high over Scandinavia caused a southerly wind over Kew and at the same time a shallow low existed over the Mediterranean. The balloon which fell in France appears not to have burst and therefore probably floated for some time before falling. These are examples of what is perhaps the most common type of reversal of wind direction. They occur when the air over the continent is cold compared with that over England.

L. H. G. D.

Drizzle under a Clear Sky

ON December 8th, 1924, Mr. P. H. Jarrold observed at Aberdeen the occurrence of drizzle under a clear sky. During the afternoon the sky had been perfectly clear, except for a fog bank along the valley of the River Don. Quite suddenly, at about 17h. G.M.T., a sheet of stratus cloud spread rapidly from the south and covered

the whole sky. This broke up and cleared with similar rapidity about 17h. 15m. By 17h. 30m. patches of strato-cumulus, inclined to lenticular form, had appeared travelling rapidly from south-south-west. During the following half-hour, up to 18h., detached masses of lower cloud passed across the sky at a speed which, considering the quiet surface conditions, was somewhat unexpected. Thus, at one moment, the whole sky would appear overcast, while three or four minutes later the only clouds visible were the isolated patches of strato-cumulus. These alternations from fine to overcast occurred continuously for at least half-an-hour. The cloud masses were classified as stratus-cumuliformis, and had an appearance resembling " pancake-ice," the edges of the separate cloudlets, composing the mass, being sharply defined. The cloud was obviously very low. During this period of varying cloudiness the air seemed to be full of moisture, outside



objects were becoming distinctly wet, and the moisture could be felt on hands and face as if a slight drizzle was occurring: this continued during the periods of clear sky.* By 18h. 15m. the stratus had become thicker, and actual drizzle fell during the greater part of the evening.

During the period of observation the SSW surface wind was increasing, rising from force 2 to force 3 by 18h.: the temperature, which had been falling during the afternoon, had begun to rise again after 17h., and continued steadily rising until midnight: the relative humidity had been rising during the afternoon, but showed a sudden rise to 96 per cent. at 18h., continuing at that figure until midnight. At the time of Mr. Jarrold's observations a shallow secondary depression was approaching Aberdeen in a general south-westerly current. At 18h. there was drizzle at Leuchars, Renfrew and Eskdalemuir. There was a certain amount of temperature variability, but no well marked " front."

The photo-barogram for the day on which Mr. Jarrold's observations were taken is reproduced above. It shows a remarkably regular series of waves during the morning of the 8th which, however, died out before 14h. Irregularities in the trace also occurred during the evening. The observer at 9 h. noted that there was " Ci and Ci-St to Ci-Cu in places with waves."

* It is not always remembered that as a rule the rain which reaches the ground has fallen from clouds which have already passed overhead.

Haze in the East Indies

THE valuable account of the climate of the Dutch East Indies, which is being published by Dr. C. Braak, has now reached Part 6.* This part includes a very interesting chapter on the "Transparency of the Air." As a general rule, transparency improves when rainfall is considerable, and on the other hand, haze increases in dry weather. In very dry years, the haziness is transformed into dense, gray fog. The worst year on record from this point of view, was 1902. Over large areas and for long periods the range of visibility was about a quarter of a mile. Navigation was conducted with great difficulty. These fogs are attributed mainly to the dust from the Australian deserts. Dr. Braak insists, however, on regarding them as affected to a great extent by the hygroscopic nature of the particles. He classes with the fogs of the East Indies gray haze observed over the Red Sea, where the number of hygroscopic particles shown by Aitken's dust-counter was small and the humidity rather low. "Apparently the dry air from the desert contains only a few, but probably very hygroscopic, particles, which increase considerably in dimensions under the influence of the rising relative humidity above the sea and form the gray fog." A more natural interpretation of the observations would seem to be that the non-hygroscopic particles form the haze. It is to be hoped that the Red Sea haze will be sampled with Dr. Owens's apparatus.

Is Lightning less dangerous in the Tropics?

Part 7 of the same publication contains some interesting statistics with regard to thunderstorms in the East Indies. The regularity of thunderstorms in the interior of Java is exemplified by the case of Buitenzorg, about 50 miles from Batavia and 800 ft. above sea level. The average number of days on which thunder occurs in the year is 322. In October and also in December the average number is 30·3. The storms always occur in the afternoon or early evening. Thunder is heard between 17h. and 18h. on 250 days a year.

In spite of the frequency of the storms the number of fatalities is remarkably low. With regard to material damage Dr. Braak writes:—

> "The cases of damage by lightning are in the Archipelago of less importance than in Europe, and it is for that reason more difficult to detect them. Cases of severe damage are rare, an exception being made by cinchona trees; these trees, however, are rather weakly built. Consequently the impression is given that cases of objects being struck by lightning are relatively rare. Careful examination, how-

*Het Klimaat Van Nederlansche-indie. Vol. I., Part 6 (with English Summaries). Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia, Verhandelingen No. 8, Batavia, 1924

ever, discloses an unexpectedly large number of cases, which otherwise would be overlooked, and, in the end, one is led to the conclusion that the actual number is larger than in Europe, as is also the case with the number of thunderstorms themselves.

As an explanation of this relatively small damage, one could assume that the tropical trees are stronger, or that their conductivity is higher. To the writer, however, it appears that the facts are explained in a more satisfactory way by the assumption that it is the intensity of the lightning discharges which is different, and that the intensity is relatively small in the tropics. In that case we are induced, furthermore, to assume that the differences of electrical potential, which are necessary to cause a lightning flash, are relatively small, which in its turn might be explained by the assumption that in the tropics the conductivity of the air is relatively high."

As to the last sentence it may be remarked that according to G. Angenheister* the conductivity is five times as great at Samoa as in Berlin. This generalization applies however to fine weather ; it might or might not be true for thunderstorms.

Meteorology in the Ukraine

THE tide of meteorological publications from Russia, which was interrupted for some years by the war, has set in again with full vigour, but instead of emanating almost exclusively from the Central Physical Observatory, the reports now come from a number of local centres. We have recently received a number of publications from the Meteorological Service of the Ukraine, which is under the direction of M. Danylevski. These include copies of a monthly weather report, which was initiated in January, 1923, some sections of rainfall tables, and a meteorological magazine. The monthly weather report is admirable : it includes ten-daily means for all stations, daily observations *in extenso* at Kieff, Kharkov and Odessa, and daily observations in less detail for a selection of other stations. Sunshine is represented by heliographic observations at 21 stations, of which four are equipped with Campbell-Stokes recorders, and the rest with Velichka recorders. Among the observations, we notice that at Odessa in winter earth temperatures are taken both beneath the snow and beneath a patch of soil which is kept bare : in January, 1924, at a depth of 40 cm. (1·3 ft.), the former averaged +2·1° C., and the latter —5·2° C, the difference of 7·3° C. illustrating very effectively the power of snow to keep the soil warm. The rainfall tables cover varying periods between 1911 and 1922 : they are issued in sections relating to different parts

* *Gottingen Abh. Ges. Wis.*, Neue Folge, Band IX., Nro. 2.

of the country, but do not include rainfall maps. The monthly magazine, the title of which signifies " Informatory Bulletin of the Ukraine," includes original articles, reviews and notices.

News in Brief

The University of Aberdeen has conferred the honorary degree of LL.D. on Dr. G. C. Simpson, F.R.S.

Dr. H. Jeffreys, Fellow and Lecturer of St. John's College, Cambridge, has been recommended by the Council for election into the Royal Society.

Dr. Jeffreys will give a lecture on " The Cooling of the Earth " at the meeting of the London Mathematical Society, to be held in the rooms of the Royal Astronomical Society, Burlington House, on April 23rd, at 5 p.m.

Mr. C. T. R. Wilson, F.R.S. has been elected to the Jacksonian professorship of natural philosophy, Cambridge. Whilst realising that Prof. Wilson's high reputation does not depend only on his work in atmospheric electricity, we are gratified to learn of this recognition by one of the older universities of the importance of a branch of meteorology.

The Sixth Annual Soirée of the Meteorological Office Staff was held on Friday, February 20th, at Australia House, London. A gathering of 250 people enjoyed a programme of music and dancing, with a comedy sketch produced by the staff of the Climatology Division. The attendance of the provincial staff was particularly gratifying, members being present from stations as widely separated as Sealand, Porton, Calshot, Andover and Felixstowe. Mr. H. W. W. McAnally, C.B., Principal Assistant Secretary of the Air Ministry, was among the guests.

The Weather of February, 1925

THE unsettled weather which had prevailed in the British Isles from January 22nd continued throughout the greater part of February, and the rainfall and mean temperature were generally above the normal for the month. During the first six days the centres of the depressions passed well to the northward of the British Isles, and high winds and gales occurred at times in a few exposed places. Showers of rain, hail or snow were recorded on most of these days, as much as 32 mm. (1·24 in.) being registered at Castle Lough (Tipperary) on the 3rd, but there were many bright periods. On the 7th, under the influence of a ridge of high pressure which moved quickly across England, sunshine records exceeded 8 hrs. in several districts of southern England, but the approach of fresh disturbances from the Atlantic caused a renewal of unsettled weather in Ireland on the evening of the

7th. These conditions spread later over the whole country, and continued until the 16th. Heavy rain fell on the 10th, 11th and 12th, *e.g.*, 82 mm. (3·23 in.) were reported from Snowdon (Carnarvon) and 38 mm. (1·50 in.) from Arkengarthdale (Yorkshire) on the 10th, and 39 mm. (1·55 in.) from Newport (Isle of Wight) on the 12th. Floods occurred in many parts of northern England. Gales were recorded on several days, a velocity of 78 m.p.h. being attained in a gust at Valencia on the 9th and Shoeburyness on the 11th. During the third week the weather became colder, quieter, and somewhat fairer. From 8 to 9 hrs. bright sunshine was experienced in many parts of the kingdom between the 18th and 22nd, but snow, sleet and rain showers occurred generally and snow lying to a depth of 6 in. was reported from Crieff (Perth) on the 21st. Maximum temperatures of 35° F. or below were recorded at a few places in northern England and Scotland on the 22nd to 24th, *e.g.*, 32° F. at Eskdalemuir on the 22nd and 35° F. at Harrogate on the 23rd. A depression approaching from the Atlantic caused high winds and unsettled weather in Ireland on the 22nd, and these conditions spread by the 24th to the rest of the kingdom. The heaviest rainfall was recorded on the 25th when 62 mm. (2·45 in.) fell at Llyn Fawr (Glamorgan) and 38 mm. (1·48 in.) at Dormans Park (Surrey). Floods were reported from the Thames Valley and many parts of Kent. The centre of this low pressure system to the west of Ireland gradually became deeper until on the 26th pressure fell below 970 mb. in many districts of the British Isles as the centre passed to the north of England. Subsequently it began to fill up and in several parts of southern England the brightest weather of the month was experienced on the 28th.

The total rainfall for the month was well above the average for most districts, being as much as 262 per cent. of the average at Llandudno, Carnarvon, 242 per cent. at Bradford, Yorkshire, and 240 per cent. at Ovington Rectory, Hampshire.

In February pressure was more than 10 mb. below normal over the British Isles, the shores of the North Sea, Denmark and southern Scandinavia. Over the Azores pressure was 10 mb. above normal and a wedge of high pressure extended northwards towards Greenland. This distribution was associated with frequent deep depressions which passed very slowly across these islands giving strong and stormy westerly and south-westerly winds. Much damage was done to shipping at the Icelandic fishing grounds and in the Bay of Biscay. Over south-western Europe the prevailing winds were more southerly. Gales were experienced in Austria, eastern Switzerland and northern Italy between the 13th and 16th. On the Salzburg-Ischl line a passenger train was blown over an embankment near St. Gilgen.

Heavy falls of snow occurred during the same period in the Lombardy Alps, and in Switzerland where much damage has been caused by avalanches in the Ticino Canton. The rainfall over western Europe was generally slightly below normal except in Sweden where precipitation, mostly snow, was slightly above normal. In western Turkey the rainfall was for the third month in succession very scanty and the crops are suffering.* Temperature was much above normal the excess being 5° F. at Zürich, 8° F. at Stockholm, 10° F. at Haparanda, and 14° F. at Spitsbergen. Between the 19th and 25th however there was a cold period in Sweden, —33° F. being recorded at Karesuando on the 24th. The ice conditions at Spitsbergen are unusual for the time of year, the islands are free of ice and the fjords are open. Thunderstorms were unusally frequent in southern Sweden early in the month.

Crops over the whole of south-eastern and south-central Africa are suffering from the results of the heavy rains, and floods have occurred on the Zambesi and Pungwe rivers causing a stoppage on the Beira-Zambesi and Nyasaland Railways. The Zambesi rose beyond the limit of the 1918 flood. A severe hailstorm was reported from Elliot towards the end of the month. Morocco has also suffered from heavy rains.

A heavy rainstorm beyond Arequipa washed away some six miles of track on the Southern Railway of Peru. In Canada the temperature was very low at times, *e.g.* —48° F. was registered at White River, Ontario, on the 2nd.

In Queensland and South Australia heavy rains occurred during the early part of the month. At Adelaide 5 in. of rain fell in 2 hours on the 6th, the worst rainstorm experienced there for 86 years. There was a change to very hot weather at Brisbane towards the end of the month.

Gales occurred off the Japanese coast on the 24th.

The special message from Brazil states that the rainfall in the central and southern regions was scanty, being 93 mm. and 85 mm. below normal respectively. No reports were received from the north. Owing to the South Atlantic anticyclone extending nearer to South America than usual there were long spells of fine dry weather. Few depressions passed across the country. The crops were generally affected by the small rainfall in the middle of the wet season. At Rio de Janeiro pressure was ·5 mb. above normal and the temperature normal.

Rainfall January, 1925—General Distribution

England and Wales ..	189	per cent. of the average 1881-1915.
Scotland	159	
Ireland	155	
British Isles	174	

*see page 35

Rainfall: February, 1925: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square.....	2·86	73	171	*War.*	Birminghm, Edgbaston	2·94	75	174
Sur .	Reigate, Hartswood...	4·53	115	221	*Leics*	Thornton Reservoir ..	3·06	78	183
Kent.	Tenterden, View Tower	3·85	98	195	,, .	Belvoir Castle.....	2·43	62	146
,, .	Folkestone, Boro. San.	3·56	91	...	*Rut .*	Ridlington.....	2·44	62	...
,, .	Broadstairs, St Peter's	2·21	56	149	*Linc.*	Boston, Skirbeck	1·91	49	131
,, .	Sevenoaks, Speldhurst.	4·39	111	...	,, .	Lincoln, Sessions House	1·66	42	114
Sus .	Patching Farm.....	4·22	107	191	,, .	Skegness, Estate Office.	2·00	51	131
,, .	Brighton, Old Steyne	4·57	116	234	,, .	Louth, Westgate	2·47	63	129
,, .	Tottingworth Park....	4·67	119	199	,, .	Brigg	2·21	56	128
Hants	Ventnor, Roy. Nat. Hos.	4·54	115	216	*Notts.*	Worksop, Hodsock....	2·21	56	143
,, .	Fordingbridge, Oaklnds	5·55	143	227	*Derby*	Mickleover, Clyde Ho..	2·90	74	176
,, .	Ovington Rectory	6·23	158	240	,, .	Buxton, Devon. Hos...	7·58	193	202
,, .	Sherborne, St. John Rec.	3·96	101	181	*Ches.*	Runcorn, Weston Pt...	4·69	119	252
Berks	Wellington College...		..	...	,, ..	Nantwich, Dorfold Hall	4·01	102	...
,, .	Newbury, Greenham..	4·63	118	210	*Lancs*	Manchester, Whit. Pk.	5·00	127	260
Herts.	Bennington House....	3·07	78	193	,, ..	Stonyhurst College....	5·86	149	175
Bucks	High Wycombe	3·64	93	197	,, ..	Southport, Hesketh...	4·18	106	199
Oxf..	Oxford, Mag. College..	3·42	87	216	,, ..	Lancaster, Strathspey.	5·48	139	...
Nor .	Pitsford, Sedgebrook..	2·79	71	167	*Yorks*	Sedbergh, Akay	8·59	218	194
,, .	Eye, Northolm.....	1·55	39	...	,, .	Wath-upon-Dearne ...	2·98	76	182
Beds.	Woburn, Crawley Mill.		..	...	,, .	Bradford, Lister Pk...	5·66	144	242
Cam.	Cambridge, Bot. Gdns.	2·45	62	191	,, .	Wetherby, Ribston H..	3·92	100	227
Essex	Chelmsford, County Lab	2·26	57	153	,, .	Hull, Pearson Park ...	1·93	49	116
,, .	Lexden, Hill House...	1·97	50	...	,, .	Holme-on-Spalding ...	3·42	87	...
Suff .	Hawkedon Rectory ...	2·90	74	191	,, .	West Witton, Ivy Ho..	5·40	137	...
,, .	Haughley House.....	1·88	48	...	,, .	Felixkirk, Mt. St. John	3·21	81	190
Norf.	Beccles, Geldeston....	1·85	47	135	,, .	Pickering, Hungate ...	3·06	78	...
,, .	Norwich, Eaton	2·03	52	124	,, .	Scarborough.....		..	...
,, .	Blakeney	2·46	63	166	,, .	Middlesbrough	2·31	59	178
,, .	Swaffham	2·73	69	174	,, .	Baldersdale, Hury Res.	5·43	138	176
Wilts.	Devizes, Highclere....	4·21	107	213	*Durh.*	Ushaw College	2·45	62	154
,, .	Bishops Cannings	4·09	104	193	*Nor .*	Newcastle, Town Moor.	2·66	68	167
Dor .	Evershot, Melbury Ho.	5·07	129	161	,, .	Bellingham Manor....	5·36	136	...
,, .	Weymouth, Westham..	3·99	101	185	,, .	Lilburn Tower Gdns...	6·05	154	...
,, .	Shaftesbury, Abbey Ho.	3·75	95	162	*Cumb*	Geltsdale.....	5·35	136	...
Devon	Plymouth, The Hoe...	3·85	98	133	,, .	Carlisle, Scaleby Hall .	4·82	123	216
,, .	Polapit Tamar	7·47	190	233	,, .	Seathwaite M.....	16·60	422	140
,, .	Ashburton, Druid Ho..	7·53	191	159	*Glam.*	Cardiff, Ely P. Stn.....	6·27	159	209
,, .	Cullompton	5·33	135	191	,, .	Treherbert, Tynywaun	16·54	420	...
,, .	Sidmouth, Sidmount ..	3·93	100	157	*Carm*	Carmarthen Friary....	7·96	202	215
,, .	Filleigh, Castle Hill ...	7·20	183	...	,, .	Llanwrda, Dolaucothy.	11·10	282	255
,, .	Barnstaple, N. Dev. Ath.	6·18	157	228	*Pemb*	Haverfordwest, School	6·98	177	201
Corn.	Redruth, Trewirgie ...	7·26	184	192	*Card.*	Gogerddan.....	9·08	231	286
,, .	Penzance, Morrab Gdn.	5·59	142	167	,, .	Cardigan, County Sch. .	6·61	168	...
,,	St. Austell, Trevarna..	7·15	182	186	*Brec .*	Crickhowell, Talymaes	8·50	216	...
Soms	Chewton Mendip	6·75	171	200	*Rad .*	Birm. W. W. Tyrmynydd	12·08	307	230
,, .	Street, Hind Hayes ...	3·53	90	...	*Mont.*	Lake Vyrnwy	9·69	246	214
Glos..	Clifton College	3·97	101	168	*Denb.*	Llangynhafal	4·61	117	...
,, .	Cirencester	4·16	106	179	*Mer .*	Dolgelly, Bryntirion..	10·01	254	225
Here.	Ross, Birchlea	4·17	106	207	*Carn.*	Llandudno	5·44	138	262
,, .	Ledbury, Underdown.	3·47	88	191	,, .	Snowdon, L. Llydaw 9	20·63	524	...
Salop	Church Stretton.....	4·77	121	217	*Ang .*	Holyhead, Salt Island.	5·29	134	217
,, .	Shifnal, Hatton Grange	3·27	83	202	,, .	Lligwy	5·62	143	...
Staff.	Tean, The Heath Ho...	4·32	110	215	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	2·68	68	163		Douglas, Boro' Cem...	5·00	127	153
,, .	Blockley, Upton Wold.	4·56	116	201	*Guernsey*				
War.	Farnborough.....	4·07	103	198		St. Peter P't, Grange Rd	3·93	100	160

Seathwaite, Monthly, January, 13.70 inches, 348 mm.

Rainfall: February, 1925: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Wigt.	Stoneykirk, Ardwell Ho	4·14	105	158	*Suth.*	Loch More, Achfary	10·47	266	159
,, .	Pt. William, Monreith .	4·78	121	...	*Caith*	Wick	3·04	77	134
Kirk.	Carsphairn, Shiel.	10·83	275	...	*Ork .*	Pomona, Deerness	3·80	97	126
,, .	Dumfries, Cargen.....	6·11	155	157	*Shet .*	Lerwick	6·29	160	199
Dum	Drumlanrig	5·33	135	140	*Cork.*	Caheragh Rectory	7·50	191	...
Roxb	Branxholme	5·10	129	194	,, ..	Dunmanway Rectory.	6·57	167	112
Selk .	Ettrick Manse.....	7·97	203	...	,, ..	Ballinacurra	3·46	88	93
Berk.	Marchmont House	5·28	134	254	,, ..	Glanmire, Lota Lo. ...	4·95	126	125
Hadd	North Berwick Res....	3·42	87	219	*Kerry*	Valencia Obsy.	7·78	198	150
Midl	Edinburgh, Roy. Obs..	3·53	90	226	,, .	Gearahameen	13·90	353	...
Lan .	Biggar	5·04	128	211	,, .	Killarney Asylum.....	6·60	168	126
Ayr .	Kilmarnock, Agric. C..	3·18	81	111	,, .	Darrynane Abbey	7·59	193	164
,, .	Girvan, Pinmore.....	6·27	159	147	*Wat .*	Waterford, Brook Lo..		..	...
Renf.	Glasgow, Queen's Pk..	3·76	95	128	*Tip .*	Nenagh, Cas. Lough...	5·95	151	191
,, .	Greenock, Prospect H..	5·33	135	95	,, .	Tipperary	4·89	124	...
Bute.	Rothesay, Ardencraig.	3·73	95	93	,, .	Cashel, Ballinamona ..	4·27	109	133
,, .	Dougarie Lodge	6·29	160	...	*Lim .*	Foynes, Coolnanes	5·85	149	183
Arg .	Ardgour House	8·56	217	...	,, .	Castleconnell Rec.	6·39	162	...
,, .	Manse of Glenorchy..	6·77	172	...	*Clare*	Inagh, Mount Callan ..	10·26	261	...
,, .	Oban	4·39	111	...	,, .	Broadford, Hurdlest'n.	6·89	175	...
,, .	Poltalloch	4·59	117	110	*Wexf*	Newtownbarry	5·12	130	...
,, .	Inveraray Castle.....	7·32	186	108	,, .	Gorey, Courtown Ho...	4·07	103	145
,, .	Islay, Eallabus.....	5·38	137	128	*Kilk.*	Kilkenny Castle	4·89	124	192
,, .	Mull, Benmore	...	..	...	*Wic .*	Rathnew, Clonmannon	3·65	93	...
Kinr.	Loch Leven Sluice	4·10	104	145	*Carl .*	Hacketstown Rectory .	5·17	131	172
Perth	Loch Dhu	8·70	221	117	*QCo..*	Blandsfort House.....	4·98	127	186
,, ..	Balquhidder, Stronvar.	6·21	158	87	,,	Mountmellick	4·62	117	...
,, ..	Crieff, Strathearn Hyd.	4·71	120	134	*KCo.*	Birr Castle.....	5·26	134	230
,, ..	Blair Castle Gardens ..	5·14	131	184	*Dubl.*	Dublin, FitzWm. Sq...	3·96	101	210
,, .	Coupar Angus School..	3·44	87	162	,, .	Balbriggan, Ardgillan .	3·79	96	193
Forf.	Dundee, E. Necropolis.	3·25	83	173	*Me'th*	Drogheda, Mornington	3·54	90	...
,, .	Pearsie House.....	5·55	141	...	,, .	Kells, Headfort.....	3·79	96	140
,, .	Montrose, Sunnyside..	3·22	82	175	*W.M*	Mullingar, Belvedere .	4·46	113	160
Aber.	Braemar Bank	6·37	162	233	*Long*	Castle Forbes Gdns....	3·62	92	127
,, .	Logie Coldstone Sch. ..	6·60	168	317	*Gal .*	Ballynahinch Castle ..	7·64	194	149
,, .	Aberdeen, Cranford Ho	...	..	...	*Mayo*	Mallaranny.....	8·14	207	...
,, .	Fyvie Castle	4·90	125	...	,, .	Westport House.....	6·07	154	154
Mor .	Gordon Castle.....	3·40	86	177	,, .	Delphi Lodge	11·99	305	...
,,	Grantown-on-Spey....	5·65	143	266	*Sligo*	Markree Obsy.	4·49	114	131
Na .	Nairn, Delnies.....	2·66	68	148	,, .	Sligo, Ard-na-veagh ..	3·89	99	...
Inv..	Ben Alder Lodge	7·27	185	...	*Cav'n*	Belturbet, Cloverhill..	3·70	94	142
,, .	Kingussie, The Birches	6·07	154	...	*Ferm*	Enniskillen, Portora ..	4·90	125	...
,, .	Loch Quoich, Loan....	12·00	305	...	*Arm.*	Armagh Obsy.	3·57	91	161
,, .	Glenquoich	9·84	250	95	*Down*	Warrenpoint	3·75	95	...
,, .	Inverness, Culduthel R.	4·51	115	...	,, .	Seaforde	3·79	96	124
,, .	Arisaig, Faire-na-Squir	4·25	108	...	,, .	Donaghadee	4·18	106	182
,, .	Fort William.....	8·27	210	111	,, .	Banbridge, Milltown .	2·81	71	135
,, .	Skye, Dunvegan.....	5·15	131	...	*Antr.*	Belfast, Cavehill Rd. .	4·13	105	...
,, .	Barra, Castlebay	2·46	63	...	,, .	Glenarm Castle.....	.	..	...
R&C	Alness, Ardross Cas. ..	6·92	176	210	,, .	Ballymena, Harryville	3·72	95	115
,, .	Ullapool.....	5·07	129	...	*Lon .*	Londonderry, Creggan	5·47	139	171
,, .	Torridon, Bendamph..	9·87	251	98	*Tyr .*	Donaghmore	4·16	106	...
,, .	Achnashellach	7·74	197	...	,, .	Omagh, Edenfel	5·09	129	171
,, .	Stornoway	5·38	137	121	*Don .*	Malin Head	3·86	98	160
Suth.	Lairg	5·49	139	...	,, .	Rathmullen.....	5·50	140	...
,, .	Tongue Manse.....	5·21	132	149	,, .	Dunfanaghy	.	..	...
,, .	Melvich School.....	3·88	99	130	,, .	Killybegs, Rockmount.	5·85	149	117

Climatological Table for the British Empire, September, 1924

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal								
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1010·9	— 6·5	72	41	63·6	52·0	57·8	+ 0·7	54·7	80	7·5	75	+ 27	19	3·9	31
Gibraltar	1016·8	— 0·5	86	61	78·5	65·6	72·1	— 0·4	65·3	71	4·4	0	— 35	0	...	...
Malta	1016·5	+ 0·8	102	67	86·2	74·1	80·1	+ 4·9	71·6	69	1·5	1	— 29	2	9·4	75
Sierra Leone	1013·5	+ 0·9	87	68	82·7	70·2	76·5	— 2·7	74·3	86	7·7	827	+102	29	...	...
Lagos, Nigeria	1011·8	— 1·0	86	72	84·6	74·3	79·5	+ 1·4	75·5	77	5·8	104	— 26	12	...	...
Kaduna, Nigeria	1016·1	+ 3·3	88	67	83·6	68·9	76·3	+ 1·0	71·9	89	0·9	235	— 25	25	...	...
Zomba, Nyasaland	1013·5	— 0·3	89	46	82·7	58·8	70·7	+ 1·6	...	77	3·1	0	— 9	0	...	...
Salisbury, Rhodesia	1013·3	— 1·4	90	37	81·7	51·9	66·8	+ 0·6	54·0	42	1·7	0	— 8	0	...	...
Cape Town	1018·8	— 0·3	75	42	65·5	52·2	58·9	+ 1·0	55·0	71	4·4	35	— 22	11	...	...
Johannesburg	1018·3	+ 0·3	82	26	69·4	47·7	58·5	— 0·8	46·6	55	2·4	35	+ 11	7	8·6	72
Mauritius	1020·0	— 0·2	80	54	75·9	61·7	68·8	— 1·3	62·6	70	5·5	27	— 6	8	7·9	67
Bloemfontein	...	...	88	27	72·4	42·3	57·3	— 1·8	46·5	54	3·1	42	+ 19	6	...	...
Calcutta, Alipore Obsy.	1006·2	+ 1·7	91	76	88·1	78·6	83·3	+ 0·3	79·2	88	7·8	250	— 13	13*	...	...
Bombay	1006·9	— 1·1	89	74	85·2	76·9	81·1	+ 0·4	76·5	88	8·9	308	+ 33	18*	...	...
Madras	1006·5	0·0	99	73	90·5	76·5	83·5	— 1·6	77·3	80	6·0	246	+115	11*	...	...
Colombo, Ceylon	1009·4	— 0·2	87	73	85·2	76·3	80·7	— 0·7	77·4	77	8·8	381	+255	21	4·5	37
Hong Kong	1009·1	+ 0·8	93	74	86·8	78·6	82·7	+ 1·7	77·0	78	6·3	164	— 82	13	7·4	60
Sandakan	...	...	92	70	88·7	74·5	81·6	— 0·1	76·5	77	...	200	— 39	15	...	...
Sydney	1015·1	— 0·9	82	45	69·4	52·1	60·7	+ 1·7	53·9	63	5·0	71	— 3	13	6·2	52
Melbourne	1014·5	— 1·3	76	40	61·7	48·2	54·9	+ 0·8	50·9	70	7·8	58	— 3	23	3·9	33
Adelaide	1015·9	— 1·6	77	40	64·1	48·5	56·3	— 0·7	51·5	69	7·1	88	+ 38	21	4·5	35
Perth, W. Australia	1017·8	— 0·1	81	42	66·9	50·2	58·5	+ 0·4	53·2	69	4·7	57	— 28	13	7·3	62
Coolgardie	1016·7	— 0·4	87	39	71·7	47·6	59·7	+ 1·1	51·8	41	3·9	23	+ 8	5	...	...
Brisbane	1017·9	+ 0·8	84	49	75·7	56·6	66·1	+ 0·8	61·4	66	3·3	30	— 22	8	8·3	70
Hobart, Tasmania	1009·1	— 1·6	66	38	58·3	44·4	51·3	+ 0·5	46·9	71	7·0	43	— 11	20	3·8	32
Wellington, N.Z.	1018·9	+ 5·4	67	35	59·4	49·2	54·3	+ 2·8	50·4	76	6·1	62	— 37	11	4·9	41
Suva, Fiji	1015·2	+ 0·9	83	65	77·7	68·7	73·2	— 1·3	69·7	79	7·5	428	+251	22	...	...
Apia, Samoa	1010·3	— 1·8	89	69	84·7	73·4	79·0	+ 1·1	75·7	86	4·2	97	— 39	12	8·3	69
Kingston, Jamaica	1012·0	— 0·2	92	68	88·1	72·6	80·3	— 1·2	74·7	78	7·6	262	+158	16	...	...
Grenada, W.I.	1013·1	+ 1·3	89	72	85·4	75·4	80·4	+ 0·2	76·3	77	5·6	128	— 77	20	...	...
Toronto	1017·9	+ 0·1	81	38	65·5	48·5	57·0	— 2·2	50·9	77	5·3	105	+ 24	12	5·6	45
Winnipeg	1015·3	+ 0·5	85	28	65·9	42·8	54·3	+ 0·9	49·0	80	4·7	92	+ 42	9	6·5	51
St. John, N.B.	1018·0	+ 0·5	69	38	61·9	48·0	54·9	— 1·0	51·9	84	5·0	65	— 30	12	5·9	47
Victoria, B.C.	1014·8	— 1·7	81	43	65·0	49·5	57·3	+ 1·7	51·5	79	4·0	57	+ 6	6	7·6	60

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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Notes on Some Characteristics of a Cold Front, February 11th, 1925

IT has frequently been remarked that the study of certain atmospheric phenomena would be assisted by the use of autographic instruments with very open time scales. At the meteorological stations at Porton on Salisbury Plain and Leafield in Oxfordshire, some of the instruments, though they have not this advantage, have the merit that the record consists of a series of dots made at minute intervals so that with a little care the value of the element at à definite instant can be identified. The accompanying diagram, by Mr. N. K. Johnson, illustrates how the draughtsman can show on a sufficiently open scale the sequence of events. The original temperature records were made by Cambridge and Paul Thread-Recorders working with aspirated platinum resistance thermometers. Only the records for the dry bulb thermometer at 4 ft. above ground have been utilised in the diagram, but records for greater heights in addition are available for discussion. The wind records have been copied from charts with the time scale 15 mm. to the hour, use being made of a system of time-marking which permits of such accuracy in synchronising the records that the error does not exceed about one minute. For pressure the record of a microbarograph is available as well as the chart from an ordinary weekly barograph, but less reliance can be placed on the curve which has been sketched in our diagram to show the pressure than on the others.

Wt 69—P 1 1000 4/25 M & C

The following account of the events is based on Mr. Johnson's notes.

The secondary disturbance which crossed the south of England on the evening of February 11th, 1925, was remarkable for the large fall of temperature which accompanied the passage of the trough. Curiously enough this happened almost simultaneously at Porton and at Leafield. It will be seen from the diagram that a warm wind from the south was replaced very quickly by a cold one from the west. The wind velocity, which had fallen steadily from 35 m.p.h. at 20h. 45m. to 24 m.p.h. at 21h. 00m., then showed a sudden gust of 43 m.p.h. of about 2 minutes' duration. The wind direction was steady until 20h. 52m., it veered through 18° in five minutes and then through 75° in the next minute.

The temperature record shows that during the four minutes, 20h. 56m. to 21h., there was a fall of 12·9° F. As the mean wind velocity was about 25 m.p.h., the width of the transition cannot have been more than 1½ miles. This estimate makes no allowance for the lag in the thermometer; the lag is, however, very small. The wet bulb trace was steady at 46·5° F. till 20h. 57m. From 21h. 1m. it was superimposed on the dry bulb trace, showing that the cold air was saturated, presumably by the falling rain. There had been steady rain up to about 20h. 30m., and a rainless interval which lasted until 21h., then there came a heavy downpour with 1·4 mm. in 7 minutes; this was followed by steady but less heavy rain.

At Leafield, the structure of the cold front was somewhat different. Both the fall of temperature and the change in wind direction occurred in two well defined stages (Fig. 1). The first stage involved a change of temperature of 5° F. and the second one of 6° F. On the assumption that the wind velocity at Leafield was the same as that at Porton, these temperature differences would be distributed over horizontal distances of about 3 miles each and separated by an interval of 10 miles. The pause in the fall of temperature at Porton (from 21h. till 21h. 4m.) suggests a structure of the same type but developed to a smaller degree. The suddenness of the change in wind direction at Leafield at 20h. 54m. may be contrasted with the steadily commencing change at Porton. The Porton thermograms show that in the warm air the temperature at 56 ft. above ground was 0·7° F. higher than at that at 4 ft. Obviously the air was being cooled by contact with the ground. At the actual time of arrival of the cold front, the "inversion" changed suddenly to a lapse of 1·0° F., the new current being colder above than below. Eight minutes later the lapse was reduced to 0·1° F. and it became steady at 0·3° F., indicating that the air was being heated from below and well stirred by convection. The wind velocity trace already

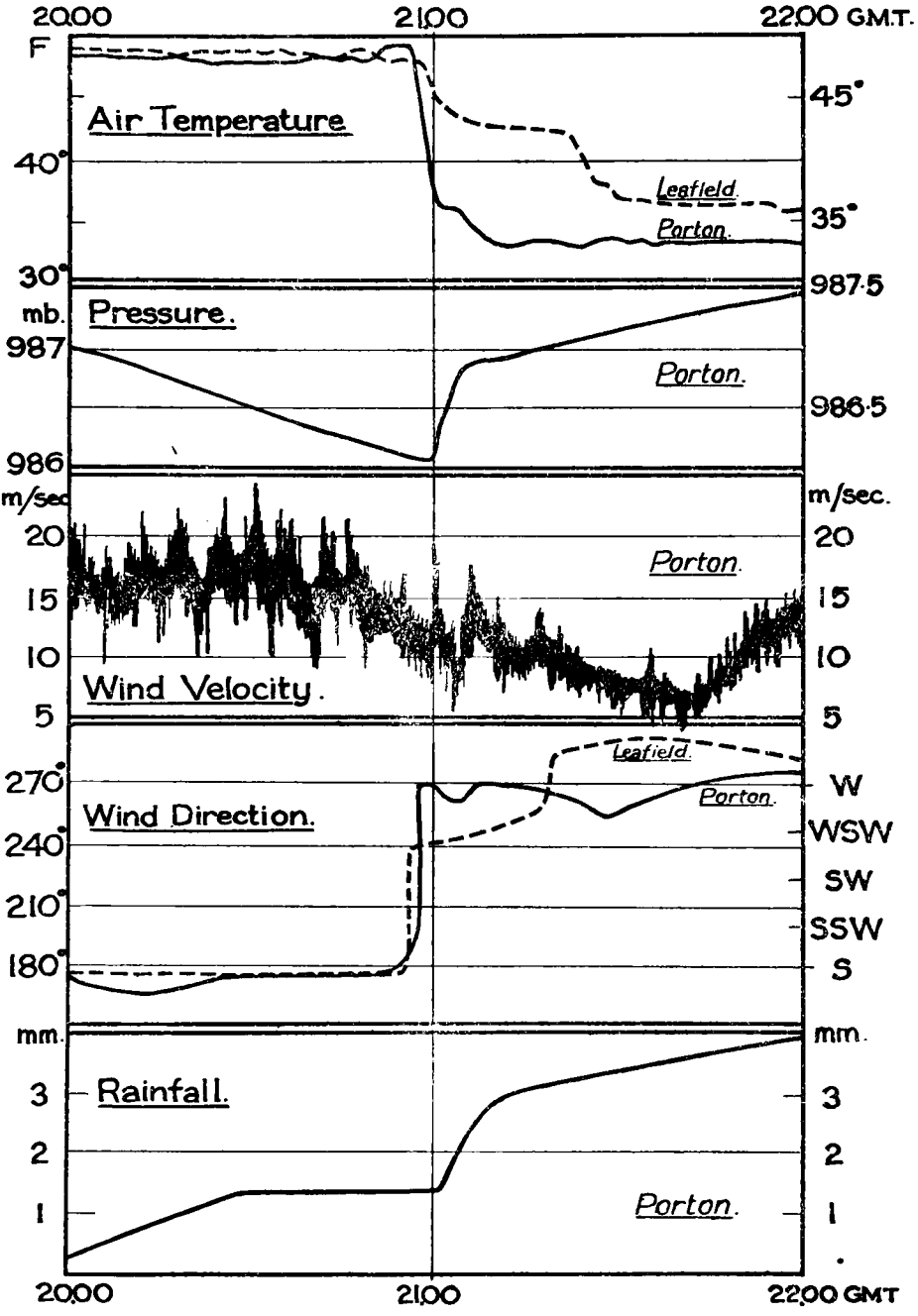

20.00
21.00
22.00 G.M.T.
F
Air Temperature
40°
30°
45°
35°
Leafield.
Porton.
mb.
Pressure.
987
986
987·5
986·5
Porton.
m/sec
m/sec.
20
15
10
5
Porton.
Wind Velocity.
270°
240°
210°
180°
Leafield.
Porton.
Wind Direction.
W
WSW
SW
SSW
S
mm.
3
2
1
Rainfall.
Porton.
20.00
21.00
22.00 GMT

FIG. I.

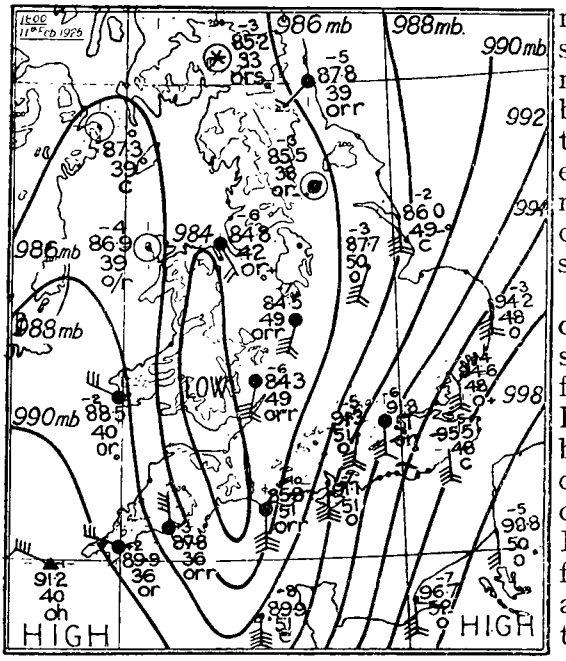


FIG. 2.

referred to in Fig. 1, shows a smaller gustiness after 21h. than before. The reason is to be found in the better exposure of the anemometer to the west as compared with the south.

In comparing the differences between the structure of the "cold front" at Porton and Leafield, reference may be made to the synoptic chart for 18h. on the date in question (Fig. 2). In the latitude of Leafield the chart indicates a difference of 9° F. in the temperatures of the equatorial and polar air (Ross 49° F., Pembroke 40° F.). Further south (Portland Bill, Cattewater) the temperature fall is 15° F. The temperature of the polar current as a whole would be lower, however, than those recorded at Pembroke and Cattewater where the air must have been warmed by the sea. The position of the "warm front" at 18h. is very clearly shown as extending in a straight line from Flamborough Head to about Shrewsbury. The warm current rising over cold air in the north of England is responsible for continuous rain over that area. On the same chart the "cold front" is along the trough of the depression from Shrewsbury southwards.

The history of this cold front invites further study with the aid of other autographic records. The reason for the belt of air of intermediate temperature might be found as well as the cause of the absence of rain in this belt. That the heavy rain at Porton began three or four minutes after the first fall of temperature may be due in part to the fact that rain takes an appreciable time to fall. In heavy rain at the rate ·01 in. per minute the drops would fall at about 15 ft. per minute and, if the cloud was 3,000 ft. up, they would take about three minutes to reach the ground. Moreover, the manufacture of the rain by the ascent of warm air over a wedge of cold air must take time, so that the cold front would have reached the station before the rain-cloud came overhead.

Another interesting point that is brought out by the records is

the contrast between the types of wind in the warm and cold currents. The warm current was well established. It had been following the same course for many hours. The position of the warm front was very stable. A straight line can be drawn on the map from near Scilly to Flamborough Head, separating the places which were reached by the warm current and had high maximum temperatures, from those with low maxima. The warm current was flowing very nearly along the isobars. On the other hand, the cold current from the west seems to have been nearly at right angles to the isobars in the region where pressure was rising. This contrast between the behaviour of winds in semi-permanent and in changing fields of pressure is of great interest.

In conclusion let us emphasize the desirability of obtaining a few true autographic records with an open time-scale. The present note demonstrates how the exact sequence of events on certain occasions cannot be traced unless time is measured by seconds. With the ordinary records it is only by a *tour de force* that minutes can be estimated.

Discussions at the Meteorological Office

March 16th, 1925. *Diagnostic and prognostic application of mountain observations.* By J. Bjerknes (Christiana, Geofys. Pub. Vol. III, No. 6). *Opener*—Mr. F. J. W. Whipple.

IT is curious that in the development of their methods of analysis of weather sequences the meteorologists of the Norwegian school made little direct appeal to upper air observations. They studied the appearance of the sky, the times at which rain occurred, and the temperature changes on the ground, and learned from these the movements of the upper winds. Mr. J. Bjerknes has now taken advantage of a visit to Switzerland to study the records of mountain observatories. In this paper he discusses the records for three days, January 31st—February 2nd, 1923, and shews in particular how a " warm front " is modified as it crosses the mountains.

It is interesting to note that in this diagnosis an important part is played by a " surface of subsidence." Over a cold surface current there is a current of drier, warmer air moving in nearly the same direction but more slowly. The boundary between these currents is a surface of subsidence. Bjerknes prefers this name to that adopted by Stüve, Abgleitfläche. The idea is that the air of the upper current is in origin identical with that in the lower, but that it has been dried and warmed by compression during subsidence and lateral spreading. In this particular instance, and we are led to believe that it may be regarded as the general rule, there was a definite inversion of temperature at the

surface of subsidence whereas there was no inversion at the boundary between the main warm and cold currents.

Admitting responsibility for the false idea that the warm front and cold front surfaces should necessarily show true inversions of temperature associated with high relative humidity above and low underneath, Bjerknes now considers that such inversions are rare. As was mentioned in the discussion this is in accordance with the results of an investigation* by W. H. and L. H. G. Dines.

The second part of Bjerknes's paper is devoted to the development of mathematical machinery whereby the acceleration of air masses may be computed in certain circumstances. Perhaps the most useful result is that if a fast moving upper current is overrunning a slower under current, the pressure gradient appropriate to the upper current will be more than is required to balance the geostrophic force of the lower current, and the air of this lower current will therefore have an acceleration to the left.

A numerical example in which the data are derived from the observations of the first part of the paper brings out the utility of this analysis and so justifies the words of the title " Diagnosis and Prognosis."

Royal Meteorological Society

THE monthly meeting of this Society was held on Wednesday, March 18th, at 49, Cromwell Road, South Kensington, Capt. C. J. P. Cave, M.A., President, in the Chair.

Sir Napier Shaw, F.R.S., and H. Fahmy, D.I.C.—The energy of saturated air in a natural environment.

In classical thermodynamics the idea of " entropy " plays an important part. The idea is very difficult, and to most students elusive ; perhaps that is why the efforts which Sir Napier Shaw has been making for many years to persuade meteorologists to consider entropy when dealing with atmospheric problems have met with little success. On the other hand, potential temperature is a comparatively simple conception. We can imagine a mass of air which is actually at low pressure and low temperature in the upper atmosphere being compressed without loss of heat until it is brought to ground level pressure and to a relatively high temperature. This is the " potential temperature " of the mass of air, and it is easy to see that for an atmosphere to be stable, the air with the highest potential temperature must be at the top. Now it so happens that the entropy of a certain mass of dry air is proportional to the logarithm of its potential temperature. The practical application of this fact is the most important advance in the present paper. The conditions of a sample of air can be represented on paper

* *Meteorological Magazine*, 58 (1923), p. 84.

ruled to show temperature on an even scale and potential temperature on a logarithmic scale. The resulting diagrams have the advantage that the co-ordinates are readily comprehensible, and at the same time the advantage which pertains to the idea of entropy, that quantities of heat are represented in the diagram by areas. In the atmosphere we have to deal with saturated air as well as with dry air, and the authors have shown how the properties of saturated air can be exhibited on the new scales and compared with the properties of the actual atmosphere as determined by upper air soundings. Plotting paper has been printed with the special ruling, and will facilitate further investigation on these lines.

C. K. M. Douglas, B.A.—On the relation between the source of the air and the upper air temperature up to the base of the stratosphere.

In his well-known investigations of the relation between the temperatures of the upper air in systems of low and high pressure, Mr. W. H. Dines correlated temperature and wind direction, and found little connection between them. He came to the conclusion that the temperature changes in the air over any one spot were due to the pressure changes rather than to the variation in the source of the air supply. Capt. Douglas, starting with the idea that the direction in which air happens to be moving at the time is not a fair indication of where it has come from, has proceeded to the detailed study of numerous cases, tracing back the air currents to see where the air was situated three days before the temperature observations. The result of his work is that there is a very high correlation between the temperature of the air and the latitude from which it has come. This result lends support to the theory that cyclones are cold because they are constituted mainly of polar air.

A. H. R. Goldie, M.A.—Waves at an approximately horizontal surface of discontinuity in the atmosphere.

In this paper the author shows how the oscillations of the atmosphere shown by clouds as well as by autographic records may originate in the transition layers between currents of warm and cold air.

Correspondence

To the Editor, *The Meteorological Magazine*

Convective Circulations in the Atmosphere

WILL you allow me to transgress on your space to amplify slightly my note on Convective Circulations in the Atmosphere in the February number ?

In a letter which I have recently received, Professor Bénard

points out that one of the first observations which he made of cellular structure in fluids, was made involuntarily in 1898, when he introduced bronze filings into melted paraffin wax in an attempt to make a solid coherer for early experiments in wireless telegraphy.

The first attempt to utilise the cellular structure in explaining atmospheric phenomena was made by M. Deslandres in the Annales de l'Observatoire d'Astronomie physique de Paris, tome IV, 1ère partie, pp. 119-123. This was stated in very general terms however.

I find from Professor Bénard that there is in French a fairly considerable literature dealing with possible applications of cellular structures in fluids. Cellular solidifications are considered in great detail in an interesting thesis by C. Dauzère, now director of the Meteorological Observatory of the Pic du Midi. M. Bénard, in a paper in Comptes Rendus, t. 154, p. 260, has discussed a possible application to explain the lunar craters by the stresses set up in a solidifying surface layer. A photograph of a wax model which actually shows craters with a central cone, from an experiment of M. Dauzère, is reproduced in this paper.

In *Nature*, February 28th, 1925, Major A. R. Low discusses a possible explanation of the polygons of stones found in the mud flats of polar regions, on the basis of cellular circulation in thick mud.

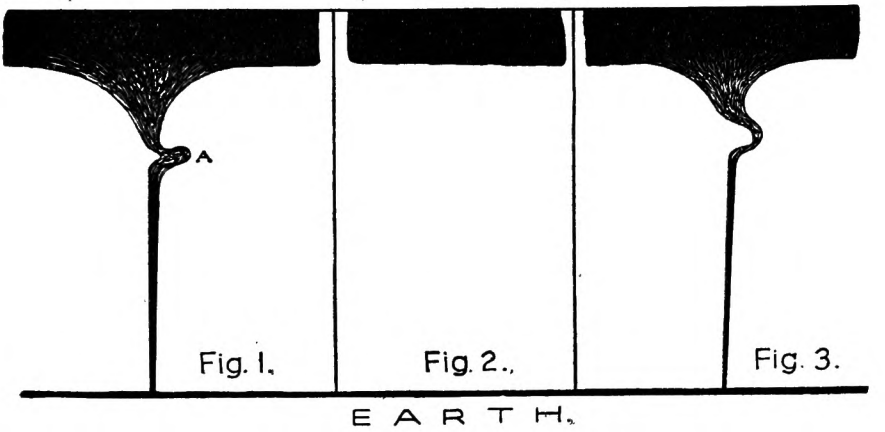
D. BRUNT.

April 6th, 1925.

A Recurrent Cloud Pendant

AT about 2.30 p.m. this afternoon while my son and I were out for a walk we saw a most wonderful sight. There had been brilliant sunshine earlier and it was quite hot, but about 2.30 a violent thunderstorm came on, and looking in the direction of the storm we saw something I have tried to represent in Fig. 1; it was black and disappeared up in the cloud above, breaking at the earth end. The blackness passed upwards leaving uniform whiteness below as it travelled up; at A it broke in a violent vortex motion, and in a short time the whole effect had disappeared. Fig. 2 represents this case, the black cloud assuming a level bottom surface again. After another short period the black portion again started from the earth as if some material were filling up an invisible tube, this rapidly rose, giving again as nearly as possible the same picture as in Fig. 1—represented by Fig. 3—this again broke at the earth and left everything blank again as in Fig. 2, when whatever it was had been literally thrown violently into the black cloud. This sequence of events went on time after time. The black streak

without the slightest doubt represented or corresponded to a flash from the cloud to the earth, that we had not seen. We watched this going on for quite a considerable time, one cannot say quite how many minutes. The straight line or narrow cone remained quite definite and sharp every time it occurred in what was just before a blank space. It was the same tube rendered visible at intervals by the uprushing blackness. As I said before, it started at the earth end filling up the tube until it produced what I have tried to draw, then broke near the earth and travelled up into the black cloud with a great rush, leaving everything below blank until the same thing repeated itself.



We were a good distance from home, and when we thought it unwise to delay any longer the phenomena was still going on.

The explanation may be that the flash struck ground that was water covered, the intense heat produced a vacuum in the patch of the flash, water was sucked up until there remained no more local water, then the break at the earth would occur ; water would next flow in from the surrounding parts, to be again sucked up, and so on, time after time. I suppose that had the flash struck a lake instead of water-covered ground, a regular water spout would have been produced, instead of the intermittent effect which we observed.

It is hard to imagine that the well-defined sharp figure could have repeated itself so many times and could last so long ; its presence being only visible or made manifest, each time the water rushed up.

How far my attempted explanation may be right, I cannot say, something did pass from the earth to the cloud time after time, rushing into the cloud in much the way shown, while after each occurrence the cloud recovered its level black appearance. The blackness of the " Flash Path " is not exaggerated in the

drawings, one could hardly draw it too black. The narrow cone part was so sharp that it would be best drawn with drawing pen and straight edge.

EDWARD E. ROBINSON.

Mount Lee, Egham Hill, Surrey. March 1st, 1925.

[It is probable that the cloud pendant was the manifestation of a local whirl and had no direct association with lightning. The apparent stiffness of the pendant is, however, a feature which is not usually mentioned in reports of such phenomena. —ED. *M.M.*]

Abnormal Weather in Rhodesia

I was interested to note your request in the December issue of the Magazine for the early report to you of any abnormal conditions, and in future I will do so by cable. The early publication of reliable information of this nature will undoubtedly be of great value.

The present rainfall has in some respects been an abnormal one in southern Rhodesia. The " early rains," during the period October to December, which are mainly associated with southerly " lows," were abnormally heavy. The mean rainfall over southern Rhodesia during this period amounted to 16·8 in., *i.e.*, 6·9 in. above normal, the previous highest total for this period was in 1917, when the mean rainfall to the end of December was 16·5 in. The usual spell of fine weather between the " early " and " general " rain periods did not occur this season, and the " general " rains, which are mainly associated with movements of the equatorial low, have also been exceedingly heavy.

There were four incursions of the equatorial low during the month of January; the daily pressure at Salisbury was never above normal during the whole period January 1st to February 19th, and the mean pressure at Salisbury during January was 0·097 in. below normal, the previous lowest being in January, 1918, when the mean pressure was 0·054 in. below normal.

C. L. ROBERTSON.

Dept. of Agriculture, Salisbury, Rhodesia. February 20th.

" A Plunge Through a Line Squall "

IN accordance with your request in the February number of the *Meteorological Magazine* (p.13), I am sending you an extract from my diary of December 31st, 1924.

> " An extraordinary squall at 14h. 30m. of wind and hail which only lasted about 10 minutes, when the sun came out. It was so dark during the squall that I could hardly read by the study window."

There were two similar squalls here on March 8th. All three

agree in their main features: they begin with a darkness so great that reading is almost or quite impossible. With this comes a high wind and a heavy fall of snow or hail lasting about 20 minutes. No thunder or lightning on either occasion. These squalls appear to me to have a well defined form deserving a name, but I do not think "Line" expresses their character, even if you think they belong to that class. "Dark" squalls would be more appropriate.

My house is 7 miles south-east from Maidstone on the south slope of the Lower Greensand ridge, close to Ulcombe Church. Ulcombe is 7 miles north-east of Mardon.

ALFRED O. WALKER, F.L.S.

Ulcombe Place, Maidstone. March 17th, 1925.

Excess of Salt in Rain

DURING the past winter I have tested the rain for salt after a very strong wind from the west and have obtained the following results though I am 6½ miles from the sea: 226, 72, 140 and 60 parts NaCl per million. I think the 1st and 3rd are almost phenomenal. Another test taken after a gale also from the west, but preceded by a few days of calm, showed only about 12 parts NaCl per million, which seems to show that the sea has to have a few days of storm before it begins to scatter the salt over the land.

The average proportion of salt in the rainfall here is about 8 or 9 parts per million. It is generally higher in the winter, and in the three months October-December, 1920, it averaged 37.* At Maryport on the sea coast I have often had 200 parts during a gale, and in fact for the three months referred to, the average was 199.

WILFRID IRWIN.

Derwent Lodge, Cockermouth. March 10th, 1925.

High Barometer and Heavy Rain

As an addition to the interesting notes by the Rev. R. P. Dansey in the *Meteorological Magazine* for February, 1925, on high barometer and heavy rain at Kentchurch Rectory, Hereford, on January 26th, I should like to append a few remarks of my own. On the day in question the rainfall here was only 0·01 in. with an east wind, but we had in Nottingham in November, 1924, a very similar experience to that of Hereford in January last. On November 11th, 1924, 0·75 in. of rain fell here (the fourth highest downpour of the year). The rain came on with the barometer about 30·25 in. and steadily rising; wind 1 p.m. south-west. When I visited the gauge on the morning of the 12th the baro-

* *British Rainfall*, 1920, p. 276.

meter was about 30·5 in. Most of this heavy rain fell with the barometer between 30·25 in. and 30·35 in., and is by far the most noteworthy example of heavy rain with a high barometer on my records of 18 years (not wholly in Nottingham).

The nearest approach was on August 14th, 1923, when 0·58 in. of rain fell here with the barometer steady about 30·2 in. ; wind 1 p.m. west, light. One of the most interesting cases was on February 25th, 1921, when 0·31 in. of rain occurred in about four hours, with the barometer rising from 30·35 in. to 30·45 in., this being practically the whole of the total rainfall for that very dry month (0·34 in.).

Taking the arbitrary double standard of ·20 in. of rain and a barometer of 30·20 in., I find that, in the 18 years I have recorded, only 10 cases reached these limits.

ARNOLD B. TINN.

107, *Burford Road, Nottingham. March 2nd*, 1925.

The Dew Pond Myth

IT would seem that every two or three years it is necessary to repeat the exposure of the Great Dew Pond Myth, as it has been rightly called. Every now and again one or other of the newspapers starts a correspondence on the subject, and the old unsubstantiated statements are made afresh.

May I ask your indulgence in order to add a few words to your notes on the subject in your January issue ? I quite realised the difficulty of measuring the rainfall on the open downs. I considered and still do consider that a pond depression receives more than the normal rainfall, and that it was in consequence of the eddies set up that more rain came to rest in such a depression than on the downs around. The words which you are good enough to quote from my book, show that the gauge which I compared with the one inside the pond depression was situated outside the bank, that is, it was on the open downs. On any other supposition than that this represents the normal rainfall on the down, it would mean that if we had half a dozen gauges at a few yards distance from one another they might all differ, as some would be more sheltered than others, and that only where sheltered they would represent the true rainfall. If there were a driving rain from the south-west and the rain were falling at an angle of 50 degrees with the ground, any temporary cause which made the rain fall in any one place vertically would result in a greater amount of rain falling there. But as I take it, rain is measured as it falls, and this is not always necessarily at right angles to the ground, otherwise it would be necessary to correct the actual observation when not falling vertically, a not frequent occurrence on the downs.

As regards the observation, that you suspect that ·25 in. would have been a better estimate of the rainfall when the pond rose ¼ in., that could only be the case if there were no margin round the pond and the sides of the pond were vertical. But round a pond there is a collecting margin, and in some ponds this area is as much as twice that of the pond surface. Clearly there is drainage from this area into the pond, and I must adhere to the measurement of my gauge which showed ·11 in.

I should like also to refer to the matter of the sea-mists. They appear as a rule before the winds reach the hill-tops, and I have watched them coming up the valleys, always then on the move. No doubt they receive fresh accessions of mist as the air rises to pass over the hills. On page 36 of my book, I have referred to the formation of mist on the hill-top and likened it to the fresh condensations of vapour which Tyndall observed on the lee side of the Matterhorn, the cloud appearing to be stationary, although in reality made up of fresh condensations of vapour. But I have not contended that all the mists come up from the sea. On page 181, I wrote—" In the early morning I have seen the mist gradually forming not only in the valleys, but on the hills. Not always do they creep up the valleys from the sea, as has been alleged." That there is an actual movement of the air from the sea sometimes is, I think, shown from the amount of sodium and chlorine found in the ponds, as also in the soils. In the analyses of pond waters which I have given, this is plainly shown, and it is also shown that the chlorine content is the smallest in the ponds farthest from the sea.

I am afraid that I do not agree that ponds without bushes are equally successful in retaining water throughout the year. But the difficulty is how to get bushes to grow in the exposed places of the downs, so that their drip is into the pond. Where it has been done, however, the result has been remarkable. The comparison between Piddingworth pond (No. 21) and High Park Wood pond (No. 31) shows this clearly, the former receiving very much drip and the latter none. They are not very far apart.

I was glad to note Walford's article in " Discovery," as every opportunity is necessary to point out the widely believed fallacy of the dew pond, and I hope his remarks will be widely read.

EDWARD A. MARTIN.

285, *Holmesdale Road, South Norwood, S.E. January 6th*, 1925.

[The point with regard to rain-gauge exposure is that if a gauge is set up on open land with no shield round it, the wind striking the gauge eddies up over the top and blows away some of the drops. The error is instrumental rather than topographical. The question is discussed in Mr. Salter's book " The Rainfall of the British Isles," pp. 65 and 273. Ed. *M.M.*]

NOTES AND QUERIES

The Green Component in Auroral Light

THE following communication from Professor J. C. McLennan was published in *Nature*, March 14th, 1925 :—

> " Dr. Shrum and I have observed in the spectrum of a mixture of air and helium, with the latter in excess, a line at 5577·35 ± 0·15. Mixtures of oxygen and helium give the line enhanced approximately to one-half the intensity of each of the yellow lines of helium.
>
> " A long discharge tube was used, surrounded over part of its length with liquid air, and the best results were obtained with a pressure of about five millimetres of mercury. The line was not observable in the spectrum of purified oxygen, hydrogen, nitrogen or helium. No mixtures of any two of these gases other than oxygen and helium gave this spectral line.
>
> " The line is narrow, very sharp, and well defined, and these characteristics, together with its wave length and the conditions under which it is observable, point to its identity with the auroral green line."

It will be remembered that a year ago Professor L. Vegard announced that he had identified the green auroral line as one of the components of the light emitted by solid nitrogen when submitted to bombardment by electrons, but that when the details of the experiments were published it appeared that the identification was not fully established. Professor McLennan and Dr. Shrum, working with more delicate optical apparatus, satisfied themselves that the spectrum of glowing solid nitrogen did not contain a component of the appropriate wave-length. Moreover, it was known that the investigation by H. D. Babcock, in which the wave-length of the auroral line was determined precisely as 5577·35 Ångström units, led to the conclusion that if the light proceeded from a gas at a temperature such as that of the upper layers of the atmosphere, that gas must be helium. The discovery by McLennan and Shrum, quoted above, is therefore in accordance with Babcock's observations. It remains to be seen under what conditions the green light from helium and oxygen is intensified so as to produce the predominant characteristic of the auroral light. Meanwhile, Professor Vegard is still pursuing his own line of investigation, as may be seen from the following cable sent by him to *Nature* on March 20th :—

> " Shown by experiments in mixtures of nitrogen and neon at the Leyden Laboratory that auroral line is the limit to which the band N_1 approaches by diminishing size of nitrogen particles."

A Personal Investigation of a Squall Cloud

THE following note by Mr. D. L. Webster appears in the *Monthly Weather Review* (Washington), December, 1924. It is of such interest that we venture to quote it in full.

"In the very interesting discussion of thunderstorms given by Dr. W. J. Humphreys in his 'Physics of the Air,' the explanation of the squall cloud, or roll scud, is especially significant because that cloud is often so different in appearance from the main mass of cumulus clouds above it, and because its explanation as a result of interaction between the upward and the downward currents is such a neat confirmation of the general theory. Because of these facts, direct observations of the motion in such a cloud are of some interest. As Doctor Humphreys informs me that records of such observations are quite rare, and I happen to have had an exceptional opportunity to make one, I venture to contribute this note in confirmation of the theory.

The occasion for this observation was a cross-country flight in October, 1918, in which Professor, then Major C. E. Mendenhall and I were over the lower Rappahannock River, Va., in a Curtis JN4H, a small but fairly powerful plane, just as a thunderstorm was getting well started. Having read Doctor Humphreys' description, and seeing a well-developed roll scud under the forward side of this storm, I decided to investigate more closely.

I had had some previous experience with the saw-tooth shaped points that often appear on the tops of fracto-cumuli subject to overrunning winds, and had noted in them eddies with horizontal axes, that could roll an air-plane flying through them remarkably suddenly. In fact, since there is plenty of room in which to recover equilibrium, such clouds make interesting opportunites for a form of safe and sane acrobatics different from those possible in still air. It appeared reasonable, therefore, to expect to confirm Doctor Humphreys' statement as to the probable rolling motions in the roll scuds, by flying into it at a small angle, so as to be headed almost along its axis, and seeing whether the airplane would likewise roll with it.

This expectation was not only confirmed, but confirmed to such an unexpected extent that the strain on the wings caused them to creak with a scream audible even through the roar of the motor. I promptly brought the machine up into a stall, to reduce the strain by reducing the air-speed, and dropped out of the cloud rolling with all the angular velocity that the most ardent upholder of this theory of thunderstorms could wish for.

The conclusion is that the theory is confirmed, as far as such an observation can confirm it, but that the experiment shares one characteristic with the famous thunderstorm experiment of Benjamin Franklin, namely, that its repetition is most decidedly inadvisable."

Wind Fluctuations in the Free Atmosphere

SOME results obtained with a pressure anemograph mounted on a captive balloon at the school of aeronautics at Petrograd have been published recently* by S. Troïtsky.

The anemograph used was Kalitin's. The reproductions show an open time-scale about one centimetre to the minute, whilst 1 metre per second is represented by 2 centimetres. There is a great contrast between the records obtained at different seasons. In winter when the stratification of the air is stable the fluctations in wind strength are very small. In summer on the other hand the fluctuations are large. At 500 metres above ground, the seasonal averages for the ratio of the amplitude of the fluctuations to the mean wind strength are ·035 and ·25 respectively. In certain cases changes of wind observed in the upper layers gradually descend to the ground. For example on one occasion a steady wind was replaced by a turbulent one of greater strength; at 375 metres above ground the change took place at 8h. 47m., at 250 metres at 9h. 2m., on the ground at 9h. 30m. The author does not seem to have noticed that the phenomenon can be pictured as the advance of a surface of discontinuity. If the surface was moving with the speed of the wind below it, *i.e.*, 5 metres per second, it would travel 13·5 kilometres in $\frac{3}{4}$ hr. The slope of the surface would be about one in 35.

An attempt was made to compare the time of occurrence of the maximum wind strength in the gusts aloft and on the ground. The maximum was found to be later on the ground, the lag being of the order 20 seconds when the balloon was at 500 metres. It is concluded that the fronts of the air waves are inclined forward in the direction of travel. It is to be hoped that this interesting generalization will be tested elsewhere.

The Airship R 33

THE successful flight of R 33 from Cardington (near Bedford) to Pulham (Norfolk) on Thursday, April 2nd, was an event of considerable importance, since it was the first flight of a British airship under the new scheme of airship development. Meteorologically the operation was interesting as it set a definite problem in precise forecasting. Owing to structural alterations at one end of the shed at Cardington, there was no choice as to which end the ship should be brought out, and it so happened that the only way was stern first. This necessitated a calm or very light

* Quelques données sur la question du développement et de la propagation verticale des ondes aériennes. S. Troïtsky. *Recueil de Géophysique publié par l'Observatoire Physique Central.* Tome IV., Fascicule 2. Petrograd, 1924.

wind (less than 5 m.p.h.) for complete safety, owing to the fact that the elevators would become exposed to the wind before the rest of the ship was clear of the shed. A desire to carry out the flight by day made an early morning start most suitable, but for this the handling party had to be warned the previous afternoon. The problem then was to forecast on the 1 p.m. chart an early morning calm for the next morning.

On Wednesday, April 1st, the pressure distribution was very "flat" over England, and calm conditions were clearly probable during most of the following night, but a depression had already commenced to spread over the country from the north-west. It was decided, however, to warn the handling party to assemble early the next morning. Later charts supported this decision, and a limit was set at 6 a.m., by which time the ship must be out of the shed. The operation was carried out at about this time, and shortly afterwards the wind rose to 10 m.p.h., and later to 20 m.p.h. from the south-west, the gradient having already increased appreciably during the night.

It would not be right to emphasise this particular instance of an airship's dependence on specially favourable weather conditions without at the same time pointing out that, but for the progress already made in airship development, the ship would never have been brought out at all at a time when a depression was spreading over the country. She was, however, to be moored at the mast at Pulham, an operation which has already been shown to be practicable in all but very bad weather. The main difficulties in handling airships arise in connection with entering and leaving sheds, but in the future these will merely be "dry docks," and between journeys the airship will rest at its mooring mast.

This good beginning is a favourable omen for the future of the Imperial Airship Service.

The Long Arm of Coincidence

In the rainfall totals as reported year by year from the many stations in the British Isles, some curious coincidences are often noticed. Some examples were given in the *Meteorological Magazine* for 1924, *pp.* 16 and 61. Another striking instance is set out below :—

Station.	1921.	1922.
Much Hadham	13·08 in.	24·12 in.
Royston (Therfield Park)	13·08 in.	24·12 in.

The two stations are both in Hertfordshire, situated some 15 miles apart. The monthly totals, although similar, are never identical, and differ in some cases by as much as half an inch.

J. G.

Distributive Stations of the Meteorological Office Aviation Services

A list of the Distributive Stations of the Meteorological Office and their Auxiliary Reporting Stations as at present established is given below.

This list supersedes that given in the *Meteorological Magazine*, January, 1923, p. 342.

The various types of stations are indicated by the letters in the first column.

Type.	County.	Station.	Lat.		Long.		Height above M.S.L.	Officer in Charge.
			°	′	°	′	Ft.	
R	Fifeshire	Leuchars -	56	23	2	52 W	40	W. Gillon.
C	Renfrewshire	Renfrew	55	52	4	24 W	36	J. J. Somerville.
C	Antrim -	Belfast	54	34	5	59 W	91	W. Andrews.
AU	Anglesey	Holyhead -	53	19	4	37 W	26	H. L. Pace.
RI	Flintshire	Sealand	53	13	3	0 W	16	H. F. Jackson.
RI	Lincolnshire-	Cranwell	53	2	0	31 W	236	W. H. Pick.
C	Warwickshire	Castle Bromwich	52	31	1	48 W	269	E. V. Stone.
R	Devonshire	Cattewater	50	22	4	8 W	82	W. L. Andrew.
R	Hampshire -	Andover -	51	13	1	31 W	295	G. L. H. Douglas-Lane.
RI	Hampshire -	Calshot	50	49	1	17 W	10	J. Durward.
U	Hants, Isle of Wight - -	St. Catherine's Point	51	27	1	17 W	120	Coastguard.
RR	Hampshire -	South Farnborough	51	17	0	45 W	230	H. St. G. Dyke Marsh.
C	Surrey -	Croydon	51	21	0	7 W	244	G. R. Hay.
RR	Suffolk -	Felixstowe	51	57	1	20 E	21	C. W. Lamb.
RU	Kent	Biggin Hill	51	19	0	2 E	597	E. L. Clinch.
C	Kent	Lympne	51	5	1	1 E	350	R. M. Stanhope.
U	Sussex -	Beachy Head	50	44	0	15 E	525	Coastguard.
U	Kent	Hythe -	51	3	1	5 E	5	Coastguard.
U	Kent	North Foreland-	51	22	1	27 E	188	Officer i/c, P.O. Wireless Station.
U	Kent	Deal	51	13	1	24 E.	20	Coastguard.

C—Civil Aerodrome.
R—Royal Air Force Station.
RI—Royal Air Force Station (Regular Lectures and Instruction given in Meteorology).
RR—Royal Air Force Station (associated with Research or Design).
A—Experimental Anemometrical Station.
U—Auxiliary Observing Station.

Possible Cotton-Growing Areas

MR. E. E. CANNEY has recently published a useful note on the areas which have a suitable climate for the growth of cotton without irrigation.* He enumerates three essential climatic

* Canney, Ernest Everett. "Rain-grown cotton and climate." *Journal of the Textile Institute*, vol. 15, p. 1533.

factors : freedom from frost during the growing season ; adequate but not excessive rainfall ; and abundant sunshine ; and he points out that the cloudy humid climate of large areas of the tropics is fatal to the economic production of good quality cotton. For the practical limits he takes :—

1. A mean annual temperature above 60° F., or where the climate is otherwise very favourable, 50° F.

2. A rainfall of between 20 and 60 in. per annum, the upper limit rising to 75 in. when other conditions are favourable.

3. A mean cloudiness of less than five-tenths ; areas with a cloudiness of six-tenths or more are regarded as extremely unsuitable.

The altitude limit is about 2000 ft. in latitude 25°, and 4000 ft. on the equator.

On this basis, maps have been prepared showing the possible cotton-growing areas, and the conclusion is reached that " there is enough land with suitable climate awaiting development to grow as much cotton as will be required for many generations." The exact delineation of the suitable areas, however, is not yet possible in many regions owing to the paucity of meteorological observations in the tropics.

Meteorological Instruments

A new catalogue of thermometers, hydrometers and pressure gauges has been issued recently by Messrs. C. F. Casella and Company, Limited. Amongst the instruments of special interest to meteorologists the bimetallic thermograph and the Assmann psychrometer may be noticed. The thermograph is listed at the moderate price of £7 10s.

Recent developments of meteorology have emphasised the value of continuous records of temperature. Observers realised long ago that if they wanted to follow the changes in the weather they should have barographs to supplement their barometer readings. Thermographs should now become equally popular. Incidentally it may be asked why instrument makers show in their catalogues what instruments like barographs and thermographs look like but very seldom reproduce records to show what they can do.

The manufacture of psychrometers of the Assmann pattern was commenced by Messrs. Casella during the war. It is well known that the reading of a wet-bulb thermometer depends on the strength of the air current past it. In the Assmann psychrometer a strong air current is produced by a clockwork fan, and consistent readings are thereby secured. The instrument is the most convenient available for determining the humidity of the air with precision. It is satisfactory to know that the

psychrometer is being manufactured in this country ; it may be recalled that the first instrument of this kind in which the dry and wet bulb thermometers were ventilated by the suction of air past them was devised by Welsh,* in 1852, for use in balloon voyages. Welsh used bellows for his aspirator.

The Course of Thunderstorms

THE relative frequency of thunderstorms at different places in the same neighbourhood would be an interesting subject for study by the members of a local scientific Society. From time to time observers make such remarks as " thunderstorms seem to have a particular objection to our little valley and go north of us over the Downs or else along the valley of the main river." On the other hand none report that they have more than their fair share of the storms. It is clear that a single observer cannot decide a question of this sort for himself. It would facilitate the discussion if we knew for the average station on open flat country the ratio between the number of thunderstorms which come within 10 miles to the number which actually pass over the station.

Some Works by Luke Howard

THE author's copy of Luke Howard's *Lectures on Meteorology* has been presented to the Meteorological Office by his grandson, Mr. E. Howard, of Ardmore, Essex, as well as a copy of *Barometrographia*, with the inscription " Robt. Howard, Tottenham, 1853. A present from his affect^e. grandfather, L.H."

The Lectures, written in 1842, present the facts " in a familiar and intelligible way." These lectures are probably of most interest now as affording a criterion by which to measure the advance made in meteorology during the past century. The physical properties of water vapour in the atmosphere and the more common optical phenomena are explained very much as they would be in a modern, popular treatise on meteorology. Whirlwinds, waterspouts, thunderstorms, aurora and meteors are ascribed vaguely to electrical causes which are almost meaningless in the light of modern physics.

" In the year 1814," Howard writes in the Introduction to *Barometrographia*, " an opportunity presented of possessing myself by purchase of a clock made by *Cumming*, on the face of which *the autograph of the curve*, made out by the rise and fall, is described by a pencil resting on the quicksilver in the short leg of the siphon while the scale revolves." Cumming, it appears, made the first instrument of this type about 1765 ; one was made

* London, Phil Trans. R. Soc. 1853, p. 311.

for George III., and another for the Earl of Bute. In *Barometrographia* the records are reproduced full size. The record sheet, some 17 inches in diameter, was turned slowly by the clock so as to make one revolution a year, so that the fluctuations of pressure for a year are conveniently presented in a single diagram.

Howard took advantage of the inner part of his records to write a weather diary and utilised other space for a general account of the weather of each year in the British Isles; these "Historical and Illustrative" notes contain a useful summary of the notable weather of the years 1815-1834. A description of the frozen Thames in the winter of 1813-14 is given. January, 1823, is described as a month of exceptionally heavy snowstorms, "six to seven feet deep on the roads to Scotland—much ice accumulated in the Thames, the navigation of which was for some time suspended as to the smaller vessels." A drought is recorded in the summer of 1826. The summer of 1834 appears to have been hot in Scotland, but the only evidence of its high temperature is contained in the following extract from the Kelso Mail: "as a singular proof of the extreme heat of the weather the whole of the honey contained in a bee-hive was melted by the heat of the sun and the bees drowned in their own sweets."

As the self-recording barometer was one of the earliest in use, it was to be expected that the records would lead to speculations. In one of his digressions on the barometer, Howard notes that southerly winds are usually associated with a falling barometer, and northerly winds with a rising barometer, and then goes on to say, "Now fair weather is always attended with evaporation: the Northerly winds coming with an increasing capacity for water as the air proceeds towards a warmer latitude. Every one of these periods marked by the upward curve may therefore be considered as *a little summer in itself*, in which the barometer rises from day to day by the accession of vapour; until, this effect being counteracted by the approach to saturation, the pressure gradually finds its level; and, decomposition ensuing, one of the short depressions intervenes, with more or less rain, to be succeeded by another ellipse [This refers to the shape of the barogram] and another summer-like period in the weather." The term "decomposition" it will be noticed, is used to indicate the separation of water (liquid or solid) from the mixture of air and water vapour.

As a tribute to Luke Howard's foresight, we quote another paragraph from the Introduction. "To promote, then, the study and *use* of the Barometer in connection with other meteorological instruments; to give a stimulus to important inquiries, already set on foot, into the nature of the atmospheric waves and currents; to occupy profitably the leisure of ingenious men,

and gratify a reasonable curiosity, are my objects in this publication. It is confessedly adapted rather to the use of the *dilettanti* in natural philosophy than of regular students: yet may the latter find in it many a problem on which to exercise their powers of investigation; to deduce cause from effect, and explore the intimate yet obscure relations between them, which make of Meteorology itself in their hands so profound a study."

Readers of *Barometrographia* will be interested to learn that the original instrument with which the curves were obtained is now an heirloom in the possession of Mr. Alfred Howard, of Chigwell.

Review

The Atmosphere and its Story. A Popular Presentation of the Science of Meteorology free from Technicalities and Formulæ. By E. Frith. Size $8 \times 5\frac{3}{4}$. pp. 204. London. The Epworth Press, 1924. 6s. Net.

MR. FRITH, who signs his preface at Pietermaritzburg, has written a pleasant, chatty book and given it a certain amount of local South African colour. The title and especially the subtitle are rather misleading however, and to that extent unfair to the unwary purchaser who thinks that he will find the difficulties of meteorology smoothed by the use of simple language, the fact being that the difficulties are hardly ever faced, the story is not half told. It is tantalising to come to the chapter heading "Why it Rains," and read "In South Africa we know something of long and dreary droughts, when we see the yellow earth sicken with thirst and the parched-up gardens and mealie lands languish for the refreshing rains. After weeks of weary waiting the heavy cumulo-nimbus clouds roll up, charged with their welcome water; the air grows sultry and still, and the animals, birds and insects disport themselves in an expectant manner. The lightning flashes, the thunder peals, and down comes the rain." A reader who had been in the habit of thinking of the clouds as so many bags of water waiting to burst would not be enlightened by this paragraph, and, indeed, he might go through the whole chapter without making much progress towards understanding why it rains. Incidentally it may be regretted that there are not detailed observations of how the animals, birds and insects disport themselves "in an expectant manner."

We like some of the tit-bits of information which Mr. Frith has gleaned from various sources: "The approximate death rate per million due to lightning in the United Kingdom is one, Belgium two, Sweden and France three each, Prussia four, United States of America eight; but if the accurate record for South Africa were known it would amaze the world";

" The Emperor Augustus suffered from most distressing emotions when a thunderstorm was in progress, and he was in a habit of retiring to a chamber underground ; " " The Eiffel Tower was struck by lightning on the 19th of August, 1889. The discharge struck the principal conductor at the summit ; it was accompanied by a terrific noise resembling the detonation of several pieces of artillery, but none of the four persons at the top of the tower experienced the least inconvenience at the time of the flash, neither were any of the meteorological instruments damaged."

It should be added that the publishers have used exceptionally nice type and made a book which it is a pleasure to handle ; the illustrations, mostly cloud photographs by Mr. E. G. Bilham, are well reproduced.

News in Brief

WE regret to announce the death, on April 9th, of Mr. George Marwood Watson, B.Sc., A.R.C.S., Junior Professional Assistant in the Meteorological Office, who had been engaged on work for the Atmospheric Pollution Committee since 1919.

We regret to learn of the death of Mr. John Maximilian Dyer, at Southbourne-on-Sea, in January this year. Mr. Dyer, who had been a master at Eton from 1888 to 1911, will be remembered by meteorologists as a volunteer who did good work in the preparation of the Admiralty Handbooks during the war.

The degree of Ph.D. has been conferred on J. Glasspoole by the University of London for a thesis dealing with the rainfall of the British Isles. The thesis included four papers which have recently been published, three in *British Rainfall* and one in the *Proceedings of the Institution of Water Engineers.*

It is stated* that at Les Alpilles Aerodrome, near St. Remy-en-Provence, Sergeant Vernard of the French Army made, if the report is accepted, a new world's " record " for gliding. He remained in the air, with the engine of his aeroplane stopped, for 9 hours 17 minutes. The previous record, 9 hours 8 minutes, was set up by Lieut. Thoret in August, 1924.

The Weather of March, 1925

OVER the British Isles generally the rainfall for March was scanty, the pressure high, and the total sunshine for the month below normal, except in the south-west. In the rear of a depression associated with local thunderstorms in south-east England

**The Times*, March 12th, 1925.

on the 1st, an anticyclone moved southwards over the Atlantic from Iceland, causing generally fair weather in the west. The eastern districts, however, came under the influence of a depression centred over the south of France, and cloudy weather occurred with high north-easterly winds and gales in the English Channel on the 3rd and 4th. During the next few days the winds backed towards the west and the weather became temporarily milder, 56° F. was reached at Kilkenny on the 6th: but a rapid rise of pressure near Iceland on the 7th resulted in a renewal of northerly winds which attained gale force in some places on the 8th. Showers of snow, sleet and hail were of general occurrence, and maximum temperature readings of below 35° F. occurred on one or two days; at Inverness on the 8th, the temperature did not rise above 32° F., and, at Andover, a grass minimum reading of 9° F. was recorded on the night of the 12th-13th. Between the 13th and 19th, the air over the British Isles was mainly drawn from a westerly source, the weather was fair and temperature rose above 55° F. on several occasions, reaching 60° F. at Kilkenny and Killarney on the 15th. Mist or fog developed locally in the early morning of most of these days. On the 19th, there was a return of the northerly winds and cold generally cloudy weather prevailed from then until the 30th. Showers of snow, hail and rain occurred generally and "snow lying" was again recorded in several places, notably on the 22nd, when the depth reported from Balmoral and also at Skegness and at Folkestone was between 2 and 3 inches. The readings of thermometers exposed over the snow were below 20° F. in some places, the reading at Balmoral on the night of the 22nd-23rd being as low as 6° F. By the 30th, the centre of the high pressure area had moved far enough south to give a warm south-westerly current from the Azores to Scandinavia. Heavy rain or snow fell in many parts of Scotland and north Ireland, 37 mm. (1·45 in.) fell at Dunfanaghy (Donegal) and 34 mm. (1·34 in.) at Renfrew.

In most parts of southern and central England and eastern and central Ireland, the total fall was less than 25 mm. (1 in.). At Purton, in Wiltshire, there was no measureable rain throughout the month.

Pressure was above normal over the greater part of the North Atlantic Ocean, western and northern Europe and at Spitsbergen, the excess being 14 mb. at Malin Head, about 7 mb. over Iceland and Spitsbergen and 13 mb. at the point 50° N, 30° W. Over the Azores and the western Mediterranean pressure was slightly below normal. Temperature was slightly below normal over most of western Europe, but at Spitsbergen the abnormally high temperature experienced from November to February still continued, the March mean being 14·5° F. above normal. On the

10th and towards the end of the month cold weather prevailed over Spain, a temperature of 12° F. being recorded at Estangento and Pvigcerdà on the 10th and at Estangento on the 22nd and 23rd. In Italy and Bulgaria conditions were mild during the first week, but later heavy snow fell in Bulgaria, a depth of 18 in. being reported from Sofia. A heavy snowstorm and high north-west winds occurred in Holland on the 8th. Towards the middle of the month, strong north-east winds and heavy seas were experienced off the Balearic Isles. Rainfall generally showed a slight deficit in western Europe. In Sweden pressure was normal in the east and about 3mb. above normal in the west. A cold spell occurred between the 7th and 16th over the country generally, temperature being about 14° F. below normal on most of these days. The rainfall distribution was irregular.

During the severe storm over Kiushiu (Japan) on March 12th, a passenger steamer was sunk near Nagasaki and it is feared many of the boats of the fishing fleet were lost.

In Rhodesia and South Africa heavy rainfall has been experienced throughout the month. The Orange river is said to have risen 37 feet,* cutting off railway communications with the south-west. An accident in which several people were killed occurred on the Cape-Natal railway near Hartshill on the 21st, owing to the collapse of the bridge over the Tugela river after the heavy rains.

On the 18th, a tornado swept across five of the Middle-West States of America, causing widespread disaster. It struck Annapolis (Missouri) about 13h. and then traversed southern Illinois, Indiana, central Kentucky and Tennessee. Many towns and villages were wiped out.

The rainfall in Australia and Tasmania was generally below normal except in North Kimberley, northern Queensland and along the north-eastern coasts of New South Wales.

The special message from Brazil states that the rainfall was scanty in the northern districts, being 34 mm. below the average, but that in the central and southern districts the rainfall was plentiful, being 41 mm. and 25 mm. above normal respectively. The pressure distribution during the month was normal. There is a general improvement in the crops due to the breakdown of the dry spell. Pressure at Rio de Janeiro was 0·4 mb. above normal and temperature 1·6° F. below normal.

Rainfall March, 1925—General Distribution

England and Wales ..	47	per cent. of the average 1881-1915.
Scotland	81	
Ireland	41	
British Isles	54	

*See *The Times*, March 24th, 1925.

Rainfall: March, 1925: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square.....	·68	17	37	*War.*	Birmingham, Edgbaston	1·10	28	58
Sur .	Reigate, Hartswood...	·74	19	34	*Leics*	Thornton Reservoir ..	1·24	31	67
Kent.	Tenterden, View Tower	1·12	28	52	,, .	Belvoir Castle.....	1·07	27	59
,, .	Folkestone, Boro. San.	1·14	29	...	*Rut .*	Ridlington.....	1·12	28	...
,, .	Broadstairs, St. Peter's	1·22	31	73	*Linc.*	Boston, Skirbeck	1·37	35	88
,, .	Sevenoaks, Speldhurst.	1·07	27	...	,, .	Lincoln, Sessions House	·80	20	52
Sus .	Patching Farm.....	·71	18	33	,, .	Skegness, Estate Office.	1·76	45	106
,, .	Brighton, Old Steyne	...	...	...	,, .	Louth, Westgate	1·98	50	93
,, .	Tottingworth Park....	1·13	29	45	,, .	Brigg	1·33	34	73
Hants	Ventnor, Roy. Nat. Hos.	·44	11	21	*Notts.*	Worksop, Hodsock....	·78	20	46
,, .	Fordingbridge, Oaklnds	·37	9	16	*Derby*	Mickleover, Clyde Ho..	·93	24	52
,, .	Ovington Rectory	·86	22	33	,, .	Buxton, Devon. Hos...	2·28	58	55
,, .	Sherborne, St. John Rec.	·42	11	19	*Ches.*	Runcorn, Weston Pt...	·84	21	42
Berks	Wellington College...	·58	15	29	,, ..	Nantwich, Dorfold Hall	1·06	27	...
,, .	Newbury, Greenham..	·50	13	22	*Lancs*	Manchester, Whit. Pk.	1·16	29	51
Herts.	Bennington House....	·80	20	44	,, ..	Stonyhurst College....	2·16	55	59
Bucks	High Wycombe	·73	19	37	,, ..	Southport, Hesketh...	1·05	27	47
Oxf..	Oxford, Mag. College..	·48	12	31	,, ..	Lancaster, Strathspey.	1·20	31	...
Nor .	Pitsford, Sedgebrook..	·88	22	50	*Yorks*	Sedbergh, Akay	2·10	53	46
,, .	Eye, Northolm.....	·70	18	...	,, .	Wath-upon-Dearne ...	·60	15	34
Beds.	Woburn, Crawley Mill.	·73	19	41	,, .	Bradford, Lister Pk...	1·05	27	43
Cam.	Cambridge, Bot. Gdns.	·93	23	63	,, .	Wetherby, Ribston H..	·79	20	41
Essex	Chelmsford, County Lab	1·07	27	62	,, .	Hull, Pearson Park ...	1·25	32	69
,, .	Lexden, Hill House...	1·15	29	...	,, .	Holme-on-Spalding ...	1·05	27	...
Suff .	Hawkedon Rectory ...	1·31	33	69	,, .	West Witton, Ivy Ho..	1·27	32	...
,, .	Haughley House.....	1·09	28	...	,, .	Felixkirk, Mt. St. John	1·61	41	82
Norf.	Beccles, Geldeston....	1·52	39	88	,, .	Pickering, Hungate ...	1·47	37	...
,, .	Norwich, Eaton	1·76	45	92	,, .	Scarborough.....	1·79	45	99
,, .	Blakeney	1·37	35	84	,, .	Middlesbrough	1·52	39	97
,, .	Swaffham	1·84	47	103	,, .	Baldersdale, Hury Res.	1·82	46	60
Wilts.	Devizes, Highclere....	·45	11	21	*Durh.*	Ushaw College	1·52	39	69
,, .	Bishops Cannings	·39	10	17	*Nor .*	Newcastle, Town Moor.	1·73	44	82
Dor .	Evershot, Melbury Ho.	·59	15	20	,, .	Bellingham Manor....	2·79	71	...
,, .	Weymouth, Westham..	·56	14	27	,, .	Lilburn Tower Gdns...	2·08	53	...
,, .	Shaftesbury, Abbey Ho.	·80	20	34	*Cumb*	Geltsdale.....	2·81	71	...
Devon	Plymouth, The Hoe...	·46	12	16	,, .	Carlisle, Scaleby Hall .	1·52	39	62
,, .	Polapit Tamar	1·13	29	38	,, .	Seathwaite M.....	4·70	119	42
,, .	Ashburton, Druid Ho..	·64	16	14	*Glam.*	Cardiff, Ely P. Stn.....	·44	11	14
,, .	Cullompton	·52	13	19	,, .	Treherbert, Tynywaun	1·52	39	...
,, .	Sidmouth, Sidmount ..	·40	10	16	*Carm*	Carmarthen Friary....	1·89	48	50
,, .	Filleigh, Castle Hill ...	1·36	35	...	,, .	Llanwrda, Dolaucothy.	2·90	74	63
,, .	Barnstaple, N.Dev.Ath.	1·08	27	41	*Pemb*	Haverfordwest, School	1·58	40	46
Corn.	Redruth, Trewirgie ...	·86	22	24	*Card.*	Gogerddan.....	1·93	49	56
,, .	Penzance, Morrab Gdn.	·81	21	25	,, .	Cardigan, County Sch. .	1·05	27	...
,, .	St. Austell, Trevarna..	1·36	35	40	*Brec .*	Crickhowell, Talymaes	1·50	38	...
Soms	Chewton Mendip	·57	15	16	*Rad .*	Birm. W. W. Tyrmynydd	2·51	64	47
,, .	Street, Hind Hayes ...	·53	13	...	*Mont.*	Lake Vyrnwy	2·12	54	50
Glos..	Clifton College	·54	14	21	*Denb.*	Llangynhafal	·97	25	...
,, .	Cirencester	·46	12	19	*Mer .*	Dolgelly, Bryntirion..	3·13	79	63
Here .	Ross, Birchlea	·52	13	26	*Carn.*	Llandudno	·90	23	41
,, .	Ledbury, Underdown.	·42	11	22	,, .	Snowdon, L. Llydaw 9	6·07	154	...
Salop	Church Stretton.....	1·27	32	54	*Ang .*	Holyhead, Salt Island.	·67	17	26
,, .	Shifnal, Hatton Grange	1·01	26	55	,, .	Lligwy	·75	19	...
Staff.	Tean, The Heath Ho...	·99	25	42	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	·60	15	35		Douglas, Boro' Cem...	1·70	43	57
,, .	Blockley, Upton Wold.	·90	23	42	*Guernsey*				
War.	Farnborough.....	·79	20	37		St. Peter P't, Grange Rd	·67	17	27

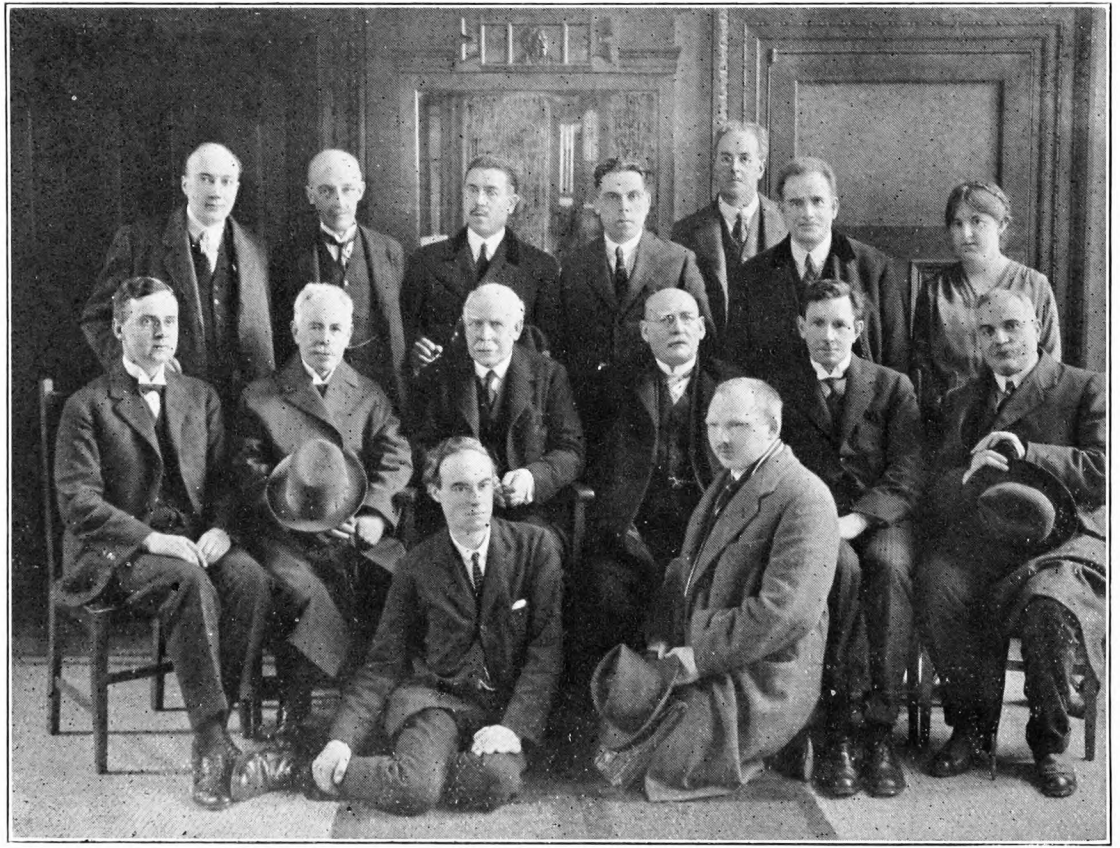
Rainfall: March, 1925: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Wigt.	Stoneykirk, Ardwell Ho	1·38	35	53	*Suth.*	Loch More, Achfary ...	8·24	209	128
,, .	Pt. William, Monreith .	1·20	31	...	*Caith*	Wick	2·31	59	102
Kirk.	Carsphairn, Shiel.	3·48	88	...	*Ork .*	Pomona, Deerness	3·04	77	108
,, .	Dumfries, Cargen.....	1·14	29	32	*Shet .*	Lerwick	2·69	68	86
Dum	Drumlanrig	1·21	31	32					
Roxb	Branxholme	2·45	62	84	*Cork.*	Caheragh Rectory	·59	15	...
Selk .	Ettrick Manse.....	2·60	66	...	,, ..	Dunmanway Rectory.	·71	18	14
Berk.	Marchmont House	3·04	77	115	,, ..	Ballinacurra	·24	6	8
Hadd	North Berwick Res....	2·15	55	114	,, ..	Glanmire, Lota Lo. ...	·35	9	11
Midl	Edinburgh, Roy. Obs..	2·26	57	128	*Kerry*	Valencia Obsy.	1·03	26	23
Lan .	Biggar	2·07	53	84	,, .	Gearahameen	2·30	58	...
Ayr .	Kilmarnock, Agric. C..	2·18	55	78	,, .	Killarney Asylum.....	2·12	54	45
,, .	Girvan, Pinmore.....	1·42	36	38	,, .	Darrynane Abbey	1·34	34	33
Renf.	Glasgow, Queen's Pk..	1·64	42	63	*Wat .*	Waterford, Brook Lo..	·54	14	20
,, .	Greenock, Prospect H..	3·55	90	72	*Tip .*	Nenagh, Cas. Lough...	·73	19	24
Bute.	Rothesay, Ardencraig.	3·52	89	98	,, .	Tipperary	·89	23	...
,, .	Dougarie Lodge	2·65	67	...	,, .	Cashel, Ballinamona ..	·47	12	17
Arg .	Ardgour House	6·00	152	...	*Lim .*	Foynes, Coolnanes	·54	14	18
,, .	Manse of Glenorchy..	4·22	107	...	,, .	Castleconnell Rec.	·83	21	...
,, .	Oban	2·39	61	...	*Clare*	Inagh, Mount Callan ..	1·53	39	...
,, .	Poltalloch	3·02	77	79	,, .	Broadford, Hurdlest'n.	·95	24	...
,, .	Inveraray Castle.....	4·56	116	72	*Wexf*	Newtownbarry	·61	15	...
,, .	Islay, Eallabus.....	2·86	73	75	,, .	Gorey, Courtown Ho...	·44	11	19
,, .	Mull, Benmore	6·80	173	...	*Kilk.*	Kilkenny Castle	·91	23	40
Kinr.	Loch Leven Sluice	1·48	38	50	*Wic .*	Rathnew, Clonmannon	·54	14	...
Perth	Loch Dhu	2·90	74	44	*Carl .*	Hacketstown Rectory .	·89	23	32
,, ..	Balquhidder, Stronvar.	2·08	53	34	*QCo..*	Blandsfort House.....	·69	17	26
,, ..	Crieff, Strathearn Hyd.	1·26	32	39	,,	Mountmellick	·50	13	...
,, ..	Blair Castle Gardens ..	2·13	54	81	*KCo.*	Birr Castle.....	·47	12	20
,, .	Coupar Angus School..	1·29	33	59	*Dubl.*	Dublin, FitzWm. Sq...	·64	16	33
Forf.	Dundee, E. Necropolis.	1·43	36	69	,, .	Balbriggan, Ardgillan .	·53	13	26
,, .	Pearsie House.....	1·40	36	...	*Me'th*	Drogheda, Mornington	·47	12	...
,, .	Montrose, Sunnyside..	1·10	28	53	,, .	Kells, Headfort.....	·65	17	24
Aber.	Braemar Bank	2·30	58	78	*W.M*	Mullingar, Belvedere .	·69	17	26
,, .	Logie Coldstone Sch. ..	2·77	70	107	*Long*	Castle Forbes Gdns....	·79	20	27
,, .	Aberdeen, Cranford Ho	...	..	...	*Gal .*	Ballynahinch Castle ..	1·81	46	35
,, .	Fyvie Castle	2·97	75	...	*Mayo*	Mallaranny.....	2·78	71	...
Mor .	Gordon Castle.....	2·35	60	101	,, .	Westport House.....	1·77	45	45
,,	Grantown-on-Spey....	3·67	93	139	,, .	Delphi Lodge	2 75	70	...
Na .	Nairn, Delnies.....	1·96	50	105	*Sligo*	Markree Obsy.	1·75	44	52
Inv..	Ben Alder Lodge	3·90	99	...	*Cav'n*	Belturbet, Cloverhill..	·92	23	33
,, .	Kingussie, The Birches	2·67	68	...	*Ferm*	Enniskillen, Portora ..	1·35	34	...
,, .	Loch Quoich, Loan....	8·50	216	...	*Arm.*	Armagh Obsy.	1·20	31	51
,, .	Glenquoich	7·47	190	77	*Down*	Warrenpoint	·82	21	...
,, .	Inverness, Culduthel R.	1·79	46	...	,, .	Seaforde	·94	24	32
,, .	Arisaig, Faire-na-Squir	2·67	68	...	,, .	Donaghadee, C. Stn...	·70	18	32
,, .	Fort William.....	4·24	108	64	,, .	Banbridge, Milltown .	1·03	26	47
,, .	Skye, Dunvegan.....	2·94	75	...	*Antr.*	Belfast, Cavehill Rd. .	1·86	47	...
,, .	Barra, Castlebay	1·64	42	...	,, .	Glenarm Castle.....	2·40	61	...
R&C	Alness, Ardross Cas. ..	3·30	84	101	,, .	Ballymena, Harryville	2·59	66	82
,, .	Ullapool.....	5·44	138	...	*Lon .*	Londonderry, Creggan	4·58	116	143
,, .	Torridon, Bendamph..	7·66	195	102	*Tyr .*	Donaghmore	1·64	42	...
,, .	Achnashellach	7·00	178	...	,, .	Omagh, Edenfel	2·00	51	64
,, .	Stornoway	3·93	100	96	*Don .*	Malin Head	2·56	65	111
Suth.	Lairg	2·89	73	...	,, .	Rathmullen.....	4·16	106	...
,, .	Tongue Manse.....	2·82	72	84	,, .	Dunfanaghy	4·01	102	110
,, .	Melvich School.....	3·54	90	124	,, .	Killybegs, Rockmount.	3·24	82	64

Climatological Table for the British Empire, October, 1924

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute Max.	Absolute Min.	Mean Values Max.	Mean Values Min.	½ max. and min.	Diff. from Normal	Mean Wet Bulb			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1013·3	− 0·7	68	33	57·5	46·8	52·1	+ 2·2	49·9	85	7·5	92	+ 23	14	2·0	18
Gibraltar	1017·8	+ 0·6	79	55	72.1	60·5	66·3	+ 0·2	61·4	75	5·1	41	− 43	6	...	...
Malta	1017·4	+ 1·7	80	63	75·5	67·4	71·5	+ 1·7	66·1	75	5·3	125	+ 57	13	5·9	52
Sierra Leone	1013·1	+ 1·1	88	67	85·9	70·6	78·3	− 1·9	75·2	79	5·4	191	−130	23	...	...
Lagos, Nigeria	1010·9	− 0·8	87	70	85·0	73·5	79·3	+ 0·2	75·9	81	7·3	397	+201	22	...	...
Kaduna, Nigeria	1014·0	+ 1·7	91	65	87·4	69·7	78·5	+ 2·2	73·9	82	0·8	26	− 34	5	...	...
Zomba, Nyasaland	1010·8	+ 0·3	92	54	85·3	62·9	74·1	0·0	...	75	4·7	22	− 16	4	...	...
Salisbury, Rhodesia	1009·5	− 1·4	91	51	82·5	58·0	70·3	− 0·5	59·3	49	3·3	48	+ 18	7	...	...
Cape Town	1017·2	− 0·2	78	40	69·0	51·8	60·4	− 0·6	57·1	70	4·8	46	+ 2	9	...	...
Johannesburg	1014·2	− 0·2	82	42	72·5	51·3	61·9	− 0·7	51·6	61	5·1	58	− 3	11	8·5	67
Mauritius	1017·1	− 1·1	81	55	77·9	61·7	69·8	− 2·9	...	70	6·3	82	+ 47	13	6·8	55
Bloemfontein	...	...	84	37	76·5	49·0	62·7	− 1·9	52·9	51	3·7	39	− 4	5	...	...
Calcutta, Alipore Obsy.	1008·4	− 1·0	95	72	88·6	76·4	82·5	+ 1·8	76·7	86	3·5	83	− 16	9*	...	...
Bombay	1010·1	+ 0·4	91	73	87·4	75·9	81·7	− 0·6	74·2	78	4·4	2	− 45	0*	...	...
Madras	1008·7	− 0·2	95	71	90·4	75·9	83·1	+ 1·0	76·7	79	5·1	122	−164	10*	...	...
Colombo, Ceylon	1010·2	+ 0·4	89	72	85·8	75·3	80·5	0·0	77·3	72	7·0	368	+ 11	18	7·5	63
Hong Kong	1012·3	− 1·3	89	64	81·2	72·7	76·9	0·0	70·0	71	6·4	231	+106	9	6·2	54
Sandakan	...	...	90	72	88·2	74·8	81·5	0·0	76·8	79	...	270	+ 16	15	...	...
Sydney	1011·2	− 3·7	90	46	73·7	55·8	64·7	+ 1·2	56·6	58	4·9	32	− 43	8	7·2	56
Melbourne	1009·4	− 5·3	81	41	66·6	48·6	57·6	0·0	53·1	64	6·9	100	+ 34	19	5·3	39
Adelaide	1010·1	− 6·0	89	41	72·3	51·9	62·1	+ 0·2	53·4	53	5·4	51	+ 7	13	6·8	53
Perth, W. Australia	1014·1	− 2·8	79	41	65·9	50·9	58·4	− 2·5	53·4	68	5·4	140	+ 86	18	7·1	55
Coolgardie	1011·1	− 4·1	88	36	74·2	48·6	61·4	− 2·2	52·5	38	4·8	19	0	4	...	...
Brisbane	1013·7	− 2·4	87	51	79·0	60·9	69·9	0·0	63·9	63	4·5	41	− 26	7	7·6	60
Hobart, Tasmania	1003·2	− 7·4	80	38	61·9	45·8	53·9	− 0·1	48·1	63	7·1	67	+ 10	22	5·4	41
Wellington, N.Z.	1007·3	− 5·0	67	45	62·9	51·5	57·2	+ 2·9	...	72	7·1	116	+ 9	15	4·8	37
Suva, Fiji	1012·8	− 0·4	87	65	81·0	69·1	75·1	− 0·9	71·5	75	5·5	319	+121	14	...	...
Apia, Samoa	1011·9	+ 0·4	89	71	85·4	73·3	79·4	+ 1·0	76·2	82	5·7	205	+ 51	16	6·7	54
Kingston, Jamaica	1011·2	− 0·3	91	69	87·4	71·7	79·5	− 1·0	74·5	78	7·0	264	+ 74	16	...	...
Grenada, W.I.	1012·0	+ 1·0	89	71	84·9	74·9	79·9	− 0·2	76·3	81	5·7	299	+113	22	...	...
Toronto	1023·4	+ 5·4	72	31	60·8	40·4	50·6	+ 3·7	43·7	79	2·5	15	− 47	6	7·0	63
Winnipeg	1014·2	− 1·1	78	28	60·5	41·0	50·7	+ 9·9	...	...	4·5	69	+ 31	7	5·3	49
St. John, N.B.	1016·6	+ 0·1	67	28	54·9	39·8	47·3	+ 2·0	43·0	81	4·3	56	− 59	8	5·9	54
Victoria, B.C.	1012·7	− 4·9	64	40	56·7	46·2	51·5	+ 1·1	48·0	86	6·9	79	+ 14	19	4·8	44

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.



THE INTERNATIONAL COMMISSION FOR THE INVESTIGATION OF THE UPPER AIR.
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to face page 81

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The International Commission for the Investigation of the Upper Air

UNDER the Presidency of Sir Napier Shaw, a meeting of the International Commission for the Investigation of the Upper Air was held in London from April 17th to the 22nd, 1925. Representatives from the following countries attended: France, Germany, Great Britain, Holland, Italy, Norway, Russia and Spain.*

At the meeting of the International Union for Geodesy and Geophysics at Madrid in October, 1924, the Union voted the sum of £500 towards the expenses of publication of a specimen volume of Upper Air Data, and Professor van Everdingen, the Director of the Meteorological Institute of Holland, promised a contribution of about £100 for the same purpose. (During the meeting in London Professor Hergesell promised a contribution of £25.)

The meeting of the Commission in London was concerned

* The photograph reproduced on the opposite page, in which the majority of the members of the Commission appear, was taken at the Meteorological Office, South Kensington, after the Saturday morning meeting. The names, reading from left to right, are:—Back row—Capt. P. Wehrlé, France; Sir Gilbert Walker, Great Britain; Col. E. Meseguer, Spain; Dr. L. Matteuzzi, Italy; Mr. L. F. Richardson, Great Britain; Prof. Dr. W. van Bemmelen, Holland; Miss E. E. Austin, Great Britain. Middle row—Dr. Th. Hesselberg, Norway; Prof. Dr. E. van Everdingen, Holland; Sir Napier Shaw, Great Britain; Prof. Dr. H. Hergesell, Germany; Dr. G. C. Simpson, Great Britain; Prof. P. Gamba, Italy. Front row—Mr. L. H. G. Dines, Great Britain; Dr. P. Molchanoff, Russia.

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primarily with the consideration of the form which the specimen publication should take.

The meetings of the Commission were divided into business meetings and scientific meetings, on the ground that a right solution of the questions which the Commission had to consider could only be achieved by a correct appreciation of the scientific principles involved. The right balance was kept by having four business meetings and three scientific meetings.

At the first meeting of the Commission on Friday, April 17th, the President read a letter from Dr. la Cour, Director of the Danish Meteorological Service, giving the Commission the welcome news that four wireless stations would be in operation in Greenland during the coming summer at Angmagsalik, Julianehaab, Godthaab, and Godhavn; all four stations would be equipped with instruments for observations of pilot balloons, but ballon-sonde ascents would not be practicable. The work of the four stations as regards investigation of upper wind would be co-ordinated by wireless with a view to obtaining simultaneous ascents to great heights from all stations at the same time.

M. Fontseré (Barcelona) sent an account of some observations on oscillations of short period, indicated by the well-known irregularities of the motion of pilot balloons, as seen in a pilot balloon theodolite. These oscillations appear to have a period of about three seconds and do not appear to be due to natural oscillations of the balloon as balloons of different shapes were tried, some being loaded with a lead weight of 65 grammes. The Commission decided to recommend that a similar investigation should be undertaken in other places and that the influence of the size and form of the balloon on the character of the oscillations should be explored and that a comparison of the oscillations observed in balloons with those observed in the tension of kite wires should also be made.

Professor Hergesell referred to the Investigation of the Upper Air at sea by Wegener and Richlbrodt, who were provided with a free passage on a merchant ship in order that they might carry out these scientific observations. Commander Garbett explained what was being done by the co-operation of the Royal Navy in obtaining upper air observations.

(On Friday afternoon, the meeting heard with obvious pleasure that the Airship R. 33, which had broken adrift in a gale on Thursday morning, had reached Pulham with all aboard safe and well.)

After some discussion of the use that should be made of the funds placed at the disposal of the President, the Commission decided that they should be applied to the publication of a specimen volume of Upper Air results for 1923 and 1924, and that in the specimen volume the observations obtained from

ballon-sonde and similar records from the places selected for international investigation, should be published in the form of tables giving full details, and that the tables should be supplemented by graphical representation on " tephigrams." This is the name given to the representation of the results of the ballon-sonde ascents, by plotting corresponding values of the temperature t, and potential temperature θ . This form of representation, which was invented by the President and explained by him at the scientific meeting, is peculiarly appropriate for presenting the results of temperature (and humidity) observations in the upper air. It shows immediately the relation of the temperature gradient observed in the ascent to the adiabatic gradient for dry air and to the adiabatic gradient for saturated air. It shows the energy which would be required to raise air vertically in the atmosphere under the conditions of the ascent, or alternatively, the energy that would be set free in a kilogram of air rising in the atmosphere under the conditions of the ascent. It also has the great advantage of presenting these results in a diagram of very moderate dimensions, even when observations at heights of 50,000 feet or more are included.

Considerable discussion took place on a proposal sent by Dr. Marvin for concentrating all the international ballon-sonde ascents in any one year into a single month. The proposal to obtain ascents daily for a month in addition to ascents on single days in other months of the year, was advocated by Lt.-Col. Gold, at the meeting at Bergen in 1921, on the ground that an International Upper Air Commission ought to deal with world conditions, and nothing less than a month would permit of general world-wide changes being investigated, but it was rejected by the Commission on the grounds that the funds available for upper air investigation should be devoted to obtaining results for detailed investigation on the lines adopted by the Norwegian Geophysical Institute. After much discussion of Dr. Marvin's proposal, it was agreed that countries participating in the international investigation of the upper air should be asked to make, as far as possible, daily ascents distributed throughout a month in each year, the month to be selected by the International Commission, these ascents to be additional to those indicated in the scheme of international days prepared by the Commission at Bergen for the years up to 1928. The first months selected for this more extended investigation is May, 1926, and the next month is October, 1927. (It was considered that the time was too short to warrant an " International Month " in 1925, but it was agreed that any auxiliary ballon-sonde results which any country might be able to make should be made in August.)

In the course of discussion of this resolution, Prof. Hergesell emphasized that the international investigation of the upper air

had two aspects, the world aspect and the regional aspect. From the world aspect ascents over a month would be appropriate, and, from the regional aspect, ascents concentrated into shorter periods of time and made more frequently would lead to better results. Dr. Simpson, following up this line of thought, made the suggestion that the Commission itself should deal only with the world aspect, and should appoint regional sub-commissions to deal with regional aspects. The Commission eventually decided that the regional aspect could, in the meantime, be dealt with satisfactorily by the nomination of Deputy-Presidents in the different regions :—

Europe with Russia, Siberia and North Africa.
North America.
The East Indies and the Philippines.
Australia.
South Africa.
South America.

It was agreed that the six ascents left at the disposal of the President under the arrangements made at the meeting at Bergen in 1921, should be concentrated in the International Months, and the exact dates in the different regions should be left to the Deputy-Presidents for these regions. Dr. Marvin was designated as Deputy-President for North America, and Mr. J. Field for the East Indies.

The question of adopting an international formula for the rate of ascent of balloons, put forward by Dr. Weinberg (Leningrad), led to the appointment of a sub-commission to consider this and other questions relating to balloons, and to report to the next meeting of the commission. The members of the sub-commission are :—

Prof. Hergesell (President), Dr. Hesselberg, Mr. J. S. Dines, Dr. Fujiwhara, Dr. Marvin, Dr. L. Matteuzzi, Dr. Molchanoff, Capt. P. Wehrlé.

The importance of aeroplane observations and the difficulty of securing satisfactory instruments for them, was emphasized by Capt. Wehrlé, and the Commission decided to ask for complete particulars of the instruments and methods used in different countries to be communicated, with a view to their publication in collected form by the French Meteorological Service.

As regards the future, it was decided that the question of a regular international publication could only be settled satisfactorily after the specimen volume had been issued and considered. The question of the publication of results subsequent to 1924 was therefore remitted to the next meeting of the Commission, which it was anticipated would be held at Prague in 1927.

Sir Napier Shaw was unanimously re-elected President of the Commission. Dr. Hesselberg asked permission to resign from

his position as Secretary of the Commission, and proposed Mr. R. G. K. Lempfert as Secretary, on the ground that it was a very great practical convenience for the President and Secretary to be in the same place. The Commission refused to allow Dr. Hesselberg to resign, but unanimously elected Mr. Lempfert as Secretary in addition to Dr. Hesselberg.

On Thursday evening, April 16th, the delegates were entertained by the President at an informal "At Home," at 10, Moreton Gardens, "to break the ice." Various graphical methods of presentation and illustration of upper air results were exhibited, and some interesting photographs were shown illustrating the growth and decay of vortices in a fluid in connection with the theory which Dr. Fujiwhara developed of the vortex motion exhibited in clouds.

On Friday, April 17th, the delegates were entertained to dinner by the Meteorological Office.

On Sunday, April 19th, they were invited by Capt. C. J. P. Cave to lunch at the Beacon Hotel at Hindhead, and subsequently to tea at Stoner Hill, Petersfield, where they had an opportunity of seeing an unrivalled collection of cloud photographs, while the rain outside witnessed to the accuracy of the Meteorological Office forecasts.

On Tuesday afternoon, April 21st, they paid a visit to Kew Observatory in connection with the 75th Anniversary of the Royal Meteorological Society, and on Wednesday evening they were entertained at the 75th Anniversary Dinner of the Society.

The outstanding impression left by the meeting may be illustrated by a remark to me of one of the foreign delegates: "What I like about this international work is the way everybody is ready to help things forward; the only consideration being 'is the thing good?' It is very pleasant."

E. GOLD.

The 75th Anniversary of the Royal Meteorological Society

IN the first volume of the *Proceedings of the British Meteorological Society* there is a quotation from *The Civil Engineer and Architect's Journal* for July, 1850: it refers to "The noble mansion of Hartwell, situated in the fertile vale of Aylesbury, and at the foot of the Chiltern Hills," and goes on: "In the spacious and elegant library Louis XVIII. attached his signature to the document which restored him to the throne of his ancestors. With objects far other than political, a few lovers of science had assembled in this room, at the invitation of the present proprietor, Dr. Lee, on the 4th of April, 1850, for the purpose of taking into consideration the present state of meteor-

ology, and of adopting such measures as might conduce to its advancement. The result of their deliberations was the formation of a Society to be called the 'British Meteorological Society'." Lee was elected Treasurer of the new Society; James Glaisher, Secretary; and S. C. Whitbread, President. Glaisher survived the Jubilee of the Society. There had been two earlier Meteorological Societies, founded in 1823 and 1836 respectively, but they seem to have been loose organisations which never reached the stage of publishing reports. The history of the present Society is continuous from 1850. One change of title occurred in 1866, when the Members of the British Meteorological Society were constituted, by Royal Charter, Fellows of the Meteorological Society. The prefix Royal was sanctioned in 1882.

To celebrate the 75th anniversary of the formation of the Society an appropriate programme was arranged. The afternoon of April 21st was devoted to a visit to Kew Observatory. The same evening there was a reception in the rooms of the Society. On April 22nd the Commemoration Meeting was held in the same rooms (the same, but not the same, for the gallant furniture and carpets, installed for one night only, had disappeared). Four distinguished foreigners, Dr. van Bemmelen, Dr. van Everdingen, Dr. Hergesell and Dr. Hesselberg, were formally presented to the President as Honorary Members, and the congratulatory letters from various scientific bodies were read out. The principal item of the programme for the Meeting was a lecture by Professor van Everdingen, the subject being the use of clouds in forecasting, both local and general. The lesson which was driven home most forcibly was the necessity for the circulation by telegraph of information about the movements of the upper clouds. The same evening there was a dinner at the Hotel Rembrandt. The after-dinner speeches were numerous and excellent, but, perhaps inevitably, too long. One point may be quoted: Sir Phillip Sassoon, in proposing the toast of the Society, referred to the latest demonstration of the practical results of the work to which its energies had been devoted during the past 75 years. "No doubt the reason why the R.33 was able to fight its way back to Pulham last Friday was the splendid skill, courage and cool-headedness of the crew, but it was in a very great measure due, and I think every member of the crew will admit this, to the vital information that the Meteorological Department was able to send to the airship during the whole of the 30-hours' trial."

It remains to be added that, as the organ of a large body of weather students in all parts of the world, the *Meteorological Magazine* conveys their congratulations to the Royal Meteorological Society on passing its 75th birthday, and wishes it all success in the future.

OFFICIAL NOTICES

IN consequence of the retirement of Dr. C. Chree, F.R.S., Mr. F. J. W. Whipple, Superintendent of the British Rainfall Organisation, and Editor of the *Meteorological Magazine*, has been appointed, on the nomination of the Meteorological Committee, Superintendent of Kew Observatory, with the rank of Assistant Director in the Meteorological Office.

On the occasion of the retirement of Dr. Chree, the Meteorological Committee at their meeting on March 11th, 1925, placed on record their high appreciation of the services he had rendered to meteorology and geophysics generally. In particular they desired to record their estimation of the value of his contribution to our knowledge of magnetism. The Committee instructed that a letter should be sent to Dr. Chree in these terms, and expressing the hope that he will continue his magnetic researches, for which the Meteorological Office will give him all possible facilities.

Correspondence

To the Editor, *The Meteorological Magazine*

A Plunge through a Line Squall

IN the February issue of the *Meteorological Magazine* a note on "A Plunge through a Line-squall" was followed by a request for further information.

The notes entered in the Pocket Register of observations at this station are as follows:—

December 31st, 1924.

7h. G.M.T. Sea and wind rose rapidly ("rather rough" by mid day) with gale force "7-8."

7h. 30m. Heavy rain shower, with strong squall (frequent later). Threatening sky from which a moderate shower fell was, followed by a clearance and at

8h. 30m. sky was "b" and the barometer rose again, while the wind of force "6-8" veered from W. to NW. temporarily. The wind then backed to WSW. and at

9h. there occurred a line-squall effect accompanied by strong winds and heavy shower of rain and hail, and a veer of wind to WNW.

It will be noted that here too the squall occurred after the rise in pressure by a lapse of half an hour. It was by no means a definite line-squall but there was evidence of all the associated phenomena—though they were mild—except for the cloud "line" which was scarcely anything more than a line of heavy cumulo-nimbus which is not uncommon in the type of weather prevailing at this period. Temperature fell at 9h. at the rate of 3° F. in an hour, rising again at 10h. from 41° F. to 47° F. at

12h. when a sudden fall of 3° took place, followed by a gradual but unsteady rise through the remainder of the day and night.

It is interesting to note that on two or three occasions during the gale period at the close of December a rise in pressure was followed closely by a backing wind, suggesting very complex disturbances in the normal pressure distribution.

T. H. APPLEGATE.

Cattewater, Plymouth. April 13th, 1925.

WITH regard to Mr. Walker's letter in your April issue about "dark squalls," I think that spells of great gloom are most apt to occur, with or without squalls, at the time of a shift of wind to the North.

I noticed an example at Godalming on the 19th, at about 13h., although the gloom lagged unusually behind the invasion of the North wind (NE in this case). People said it was due to drift of smoke from London, but this theory involves an over-pessimistic view of normal conditions here, and does not account for such occurrences in other parts of the country.

Someone tells me that the London sky is often darkened by celebration of the Sunday joint cult, but, even if this feast contributed to the case mentioned, one imagines that the main cause is connected with a fall of temperature. Can you say if this is so?

G. WESTON.

Conservative Club, St. James's Street, S.W.1. April 23rd, 1925.

[These "dark squalls" are usually associated with instability showers which occur when a polar air current is passing over warm land or sea, *i.e.*, in cold air which is being warmed from the bottom.—ED. *M.M.*]

Possible Errors in Annual Rainfall Totals obtained by the Summation of Daily Records

FOR records (in inches) made for the Meteorological Office only two places of decimals are employed. But the numerical statement of a measurement is never more than an approximation to the actual observation. Thus, the record ·01 or 1/100 of an inch simply means that the amount of rain observed was more than ·005 and less than ·015 in. In computing the rainfall of a whole year, we are therefore adding together 150 to 250 numbers, most of which contain fractional inaccuracies, and, as far as I know, nobody has ever attempted to ascertain whether in the long run these errors tend to aggravate or to annul each other.

There are two methods by which these accumulating errors

can (in the record for the whole year) be reduced to an insignificant amount:

1. The very open scale of the new graduated measure* makes it quite possible for an observer to read to three decimal places and thus to produce a record in which the individual inaccuracies are only about a tenth the magnitude which was possible with the older forms of graduated cylinder.

2. If all the water removed from the gauge is (after measuring) poured into a bottle, which can be stoppered to prevent evaporation, it can be re-measured in bulk at long intervals—say once a month, and this measurement will be free from the accumulated inaccuracies of the arithmetical summation.

From January 1st of this year I have been employing both these methods, and hope to continue them throughout the year, but it may interest observers to see the result of the first three months.

Total Rainfall of January, February and March, 1925.

Arithmetical total of 48 daily records to 2 decimal places	5·01 in.
Arithmetical total of 60 readings to 3 decimal places (This includes 12 " traces " which would not appear in the summation of the official record)	5·005 in.
Re-measurement, at end of each month, of the stored water	5·01 in.

From this short set of observations it would appear that the excess and deficiency errors tend to compensate one another, and that the total for the year may be fairly accurate in spite of the inaccuracy of the daily items of which it is the sum.

MORTYN J. SALTER.

Bank House, Mickleton, Glos. April 2nd, 1925.

Abnormal Weather at Ross-on-Wye

February was actually the eleventh consecutive month with excess of rainfall here. I cannot find a parallel to this, at all events not within the past 50 years. In 1903, each of the first ten months experienced a rainfall above normal. The average rain for the eleven months (April to February inclusive) is 26·22 in. and the actual fall in 1924-5 for same period reached 39·51 in. (over 50 per cent. surplus). The number of " days with measurable rain," however, was only 182, or 9 above the average for the period.

The past season has been strikingly abnormal. Time and again the highest maximum temperatures have been registered at such places as Skegness, Southend, Margate, Folkestone, whilst the mean temperature of some of the winter months has

* See *Meteorological Magazine, Sept.*, 1924, *p.* 193.

actually been higher in Kent, Essex and Sussex (also in London), than in parts of western England. This is strangely at variance with the long accepted truth that in winter isotherms tend to run north and south and show an increase in warmth with westerly longitude.

F. J. PARSONS.

The Observatory, Ross-on-Wye. March 7th, 1925.

[On the days in question (*e.g.*, February 13th and 26th), the general run of the isobars was from south-west to north-east over southern England with the centre of the depression near Ireland. The air which passed over eastern England during the day came from south of latitude 50° while that over western England came from a more northerly source, in the rear of the depression.

In March the succession of months with rainfall above normal was broken, the total rainfall for that month being only 14 mm. or 26 per cent. of the normal.—ED. *M.M.*]

NOTES AND QUERIES

The Airship R.33

THE breakaway of R.33 from her mooring mast at Pulham during stormy weather on April 16th, and her successful return, have already been widely reported, and the general circumstances of the event will be known to all. It may not, however, be superfluous to give here a few notes on the meteorological conditions prevailing at the time, as these have not been adequately dealt with in other accounts.

The period of strong westerly winds at Pulham commenced about 6 a.m., Wednesday, April 15th, with a depression centred close to the north coast of Scotland, and moving very little. Throughout Wednesday, while R.33 was still at the mooring mast, conditions were very squally, the mean wind fluctuating considerably, and a speed of 40 m.p.h. in gusts was frequently shown on the anemobiagraph record. The squalls were accompanied by showers of rain and hail. A particularly pronounced squall occurred about 8.45 p.m. At 8.40 p.m., after an interval of light winds, the wind was still only 4 m.p.h. Ten minutes later it was reaching 40 m.p.h. in gusts. This squall was accompanied by hail and thunder. It will be seen, therefore, that the ship successfully rode out some very bad weather during the day preceding her involuntary cruise, and it may be mentioned that during the whole of this period there was an emergency crew on board sufficient to handle the ship if she had broken away sooner.

During Wednesday night a secondary depression developed near the Hebrides and moved across southern Scotland to a position close to Newcastle by 7 a.m., Thursday, April 16th. On the southern side of this the westerly wind shown by the Pulham anemobiagraph became much steadier (*i.e.*, less squally), but gradually rose, and at 9.50 a.m. R.33 broke away from her moorings. At this time the anemobiagraph showed gusts up to 45 m.p.h., but, allowing for the greater height and more open exposure of the mooring mast, it is probable that the ship was exposed to speeds 20 per cent. to 25 per cent. greater than this.

The upper wind was of the order of 60 m.p.h. from west, and the ship was soon carried away over the North Sea, the damaged condition of her bow imposing a limit on the air speed available. It then became a nice problem in navigation to manœuvre the ship back to Pulham, taking into account the supply of petrol on board. Throughout the cruise, meteorological advice was passed to the ship, through Major G. H. Scott at Pulham, and on the basis of this the ship was manœuvred to make as much northing as possible while still in the strong westerly current on the southern side of the depression. Her motion at this time was towards the centre of the system. The depression was meanwhile passing across the North Sea to Denmark, and when, about 4 p.m., the north-westerly wind in its rear overtook R.33 she was off Texel. It was not expected that this north-westerly wind would remain for long greater than the air speed available for the ship, and, in fact, R.33 was driven by it no farther south than the region of Ymuiden (Holland), in about the same latitude as Pulham. Here she held her own from about 8 p.m., Thursday, April 16th, until 3 a.m., Friday, April 17th, when the ridge of high pressure already over the British Isles extended its influence to Holland, leading to a considerable diminution of wind speed over the southern North Sea. R.33 arrived at Pulham about 3.20 p.m., Friday, April 17th, when the crest of the ridge of high pressure lay over the station and a new Atlantic depression was already affecting the west of the British Isles. Shortly afterwards she was safely in her shed, after a cruise lasting nearly 30 hours.

The whole incident was a very skilful application by the airship staff of meteorological advice, and it only serves to emphasise how enormously important will be the meteorological organisation now being worked out for the airship routes to Egypt and India.

In conclusion, we offer our congratulations to Flight-Lieut. Booth and his crew on their very gallant and skilful performance in bringing R.33 back safe, though damaged, to her base at Pulham.

The Average Rainfall in the Isle of Wight

THE following table showing the average rainfall at Totland Bay, in the Isle of Wight, for different periods, has been contributed by Mr. John Dover.

Month.	10 years 1915-1924.	20 years 1905-1924.	30 years 1895-1924.	37 years 1888-1924.
	In.	In.	In.	In.
January ...	3·14	2·73	2·56	2·50
February ...	2·24	2·06	2·10	2·00
March ...	2·25	2·56	2·39	2·24
April ...	1·96	1·88	1·87	1·79
May ...	1·80	1·60	1·67	1·65
June ...	1·24	1·60	1·70	1·71
July ...	2·69	2·12	1·88	2·13
August ...	2·22	2·22	2·28	2·37
September ...	2·59	2·25	2·31	2·23
October ...	3·09	3·98	3·75	4·08
November ...	2·05	2·67	2·67	2·78
December ...	3·84	3·84	3·58	3·33
YEAR ...	29·11	29·51	28·76	28·81

It will be noticed that in the last ten years the three winter months December, January and February, have all been wet; so have April, May, July and September. On the other hand, June, October and November have been dry. October and November yielded 5I in. in the last ten years; 8I in the previous ten. Of the whole period the wettest month was October, 1891, with its 10·45 in. The great drought, which began with February, 1921, and lasted so long, had a great effect on the springs of this neighbourhood for the three succeeding years. The rainfall for the 49 months beginning February 1st, 1921, and ending February 28th, 1925, amounts to 116·30 in. This is below the average of 117·92 in.

Floods in Peruvian Desert

AN account of the unusually heavy rains which caused great damage in southern Peru during the last ten days of January, is given in the March number of the *Bulletin of the American Meteorological Society*. The Harvard Observatory at Carmen Alto reported that the rainfall in the Arequipa region was the greatest since February, 1893. The average annual rainfall there is about 100 mm. (4 in.), but during the last ten days of January 132 mm. (5·18 in.) were recorded.

Floods occurred in many parts of the desert, and on the

Southern Railway, between Arequipa and Mollendo, bridges have had to be constructed over gulleys washed out by the floods. Much of the desert has been converted into a fertile plain, as, owing to the unusual rain and warmth, thousands of hardy seeds, which had lain dormant in the ground through the long period of drought, have grown with incredible vigour. The desert is interlaced with streams. The greatest loss is that of the guano on the islands off Peru.

In explanation of the heavy rains, Dr. R. C. Murphy, Assistant Director of the American Museum of Natural History, points out that a warm ocean current called El Nina, or the Child, because it generally comes before Christmas, reached the coasts of Ecuador on January 12th, three weeks later than usual, and sweeping along the west coast of South America, passed further to the south and in greater volume than has been known before. Normally the southern coasts of Peru are washed by the cold Humboldt current, which flows northwards, and no rain falls between these coasts and the Andes, the prevailing winds being S E. This year the warm current, El Nina, flowed southwards, passed these coasts to Chile, and heavy rain fell in many places where ordinarily there is no rain. The speed and temperature of the current was measured on January 12th, when it reached Ecuador. It was found that the temperature of the ocean rose from 63 to 75 degrees in a day.

When is most Dew Deposited

IT is common knowledge that dew is to be found on the grass very soon after sunset in suitable weather and that there is most dew in the early morning. There are apparently no systematic observations of dew to show how much is deposited from hour to hour. Will any observer who has to be up at night undertake an investigation? The question is of considerable interest, because the rate at which dew is forming must be related to the state of the sky, the strength of the wind and its turbulence, as well as to the humidity of the air and the condition of the soil.

A method of measurement of the amount of dew was evolved by Dr. V. Parchinger* and should be appropriate for the present problem. The dew is sopped up on blotting paper and the increase of weight gives the amount of dew.

The Evaporation of Small Waterdrops

IT is a well-known theorem of Lord Kelvin's that the vapour pressure over a convex liquid surface is greater than that over a plane surface. It is a corollary from this theorem that small drops of liquid should evaporate even when in a saturated

* *Met. Zs.* 35 (1918), p. 48.

atmosphere, and, moreover, the smaller the drop the more rapid should be the evaporation. The question, how is it that clouds and drizzle persist, has not been faced by most meteorologists. Two Russian physicists (who do not seem to have been interested in drops as meteorological phenomena) have published recently the results of some experiments which throw new light on this question.*

In these experiments single drops were watched for long periods—up to an hour or more. The drop under observation was kept from falling by the adjustment of the strength of an electric field; the field was occasionally annihilated, the drop began to fall, and, from the rate at which it fell, the radius could be calculated. Before the drop was out of sight it was rescued by switching the electric field on again.

The drops used were between 1μ and 3μ in diameter, and therefore small for cloud particles.

The first result of the investigation is that a newly formed drop evaporates quickly but that the process gets slower and slower. The rate of evaporation depends on the atmosphere. In a hydrogen atmosphere the drops disappear so quickly that measurements are not possible, and, on the other hand, in an atmosphere of carbon dioxide evaporation is slower than in air. It is thought that the action is due to the gas absorbed by the water; the authors suggest that when the water of the drop is well aerated the molecules reach the surface with difficulty and evaporation is retarded.

The investigation included a search for any effect of varying the electric charge on the drops. It was found that with the range of charges that was practicable the rate of evaporation was not affected.

The Lesson of the Grimy Bridge

THE reading of the "Lesson of the Grimy Bridge" in the March number of this magazine has been questioned by more than one reader on the ground that steam trains pass occasionally along the District Railway as well as electric trains. It must be pointed out, however, that even if the smoke deposited on the bridge does come from the steam engines it remains to be explained why it is that over either pair of metals the smoke patch is on the forward side of the bridge.

The Scope of Irrigation in South Africa

IN the *Geographical Journal* for April there is an interesting article by Mr. C. Daryll Ford on "Irrigation in South Africa."

* Die Verdampfung kleiner Wassertropfen. N. Gudris and L. Kulikowa. *Zeitschrift für Physik*, vol. xxv., part 2. Berlin, 1924.

He points out that a reliable rainfall of 24 inches a year, well distributed through the seasons, is necessary for agriculture without irrigation, but about half of South Africa receives less than 15 inches a year, and the rainfall occurs mainly in summer, when it is of least use. The annual evaporation is 60 or 70 inches, and as the rain falls in short heavy showers preceded and followed by intense sunshine, it is largely re-evaporated without penetrating the soil. There is thus great need for irrigation, and as this need is greatest in spring, when the rainfall is least, water has to be conserved from the winter. Unfortunately only a small part of the soil is rich enough to warrant the expense of such works.

Danish Meteorology

THE Danish Meteorological Institute has always paid great attention to marine meteorology and since 1880 has published a Nautical-Meteorological Annual. The volume for 1924 which has recently been received, contains a large amount of information relating to the meteorology of the North Atlantic and Arctic waters. Special attention is devoted to ice ; the ice conditions in Danish waters during the winter 1923-1924 are fully described, with a chart, while the well-known series of reports and charts of ice-conditions in Arctic waters is continued. Two charts showing the drift of bottles from the neighbourhood of Iceland are given, followed by a series of monthly charts of surface temperatures in the North Atlantic. The greater part of the volume is occupied by detailed observations at a number of light-ships in Danish waters, including observations of wind, cloud and weather, air temperature, currents and sea temperature at the surface and at various depths. The volume concludes with a bibliography of the publications of the Nautical Department of the Danish Meteorological Institute since 1880.

Reprints of Meteorological Papers

ABOUT two years ago it was arranged that reprints of papers on meteorological subjects appearing in the *Proceedings of the Royal Society* should be available for fellows of the Royal Meteorological Society. Fellows wishing to take advantage of this privilege were asked to make a deposit of ten shillings to cover the cost of the reprints and of postage. Several papers of great interest to meteorologists have been circulated and the long standing grievance that the Royal Society gets the cream of English work in our branch of science is almost eliminated. The arrangement has recently been extended to include meteorological papers published in the *Philosphical Magazine*. The last papers to be circulated were " On the Formation of Water Waves

by Wind," by Harold Jeffreys from the *Proceedings of the Royal Society* and "Turbulence and Vertical Temperature difference near Trees," by Lewis F. Richardson from the *Philosphical Magazine*. Mr. Richardson's paper is the one he communicated to the British Association at Toronto. It is announced that the first ten shilling deposits have now run out. It will be interesting to learn how many fellows show their appreciation of the scheme by renewing their support. It would be highly advantageous if meteorologists publishing papers in other non-specialised journals could utilise the organization and thereby place their work in the hands of those who are most likely to be interested in it.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1924.

Unit: one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays).

Averages for Readings

		Jan.	Feb.	Mar.
Cloudless days:—				
Number of readings	n	0	5	5
Radiation from sky in zenith ...	π I	—	458	393
Total radiation from sky ...	J	—	493	420
Total radiation from horizontal black surface on earth ...	X	—	661	659
Net radiation from earth ...	X—J	—	168	239

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

Cloudless days:—				
Number of readings	n_0	0	3	2
Radiation from sky in zenith ...	πI_0	—	17	30
Total radiation from sky ...	J_0	—	24	39
Cloudy days:—				
Number of readings	n_1	3	1	2
Radiation from sky in zenith ...	πI_1	20	22	98
Total radiation from sky ...	J_1	15	23	89

Unit for I = gramme calorie per day per steradian per square centimetre.

Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

Review

Why the Weather? By C. F. Brookes, Ph.D. (Harvard). 8vo, $7\frac{1}{2} \times 5\frac{1}{4}$, pp. xvi. + 310. (*Illus.*) New York: Harcourt, Brace and Company; and London: Chapman and Hall, Ltd. 1924. 8s. 6d. net.

Daily explanations of the weather, given by Dr. Brooks to classes at Clark University, were reported to a local newspaper; these publications aroused interest, and led to the preparation of similar but more generalised short notes, which have appeared in various United States and Canadian newspapers. These notes now appear in book form. There is need for a book to which reference can readily be made when a reliable explanation of weather happenings is wanted. "Why the Weather?" with its ample index and concise paragraphs (each paragraph has its own heading) covering a wide meteorological field, meets this need excellently. At the same time a connected story of the weather has been maintained, commencing with the phenomena most common to spring and continuing through each of the seasons in turn. The writing is always entertaining, and the reader's interest is never allowed to flag. What could be better in a popular book than: "The fact that dark colours absorb the heat of the sun while light colours reflect it, thus permitting a surface to remain cool, is put to good use in the Sierra Nevada Mountains. In the spring the highways of the high passes are buried deep in accumulations of snow, sometimes even to a depth of 30 feet, and the normal rate of evaporation is so slow that automobile traffic is seriously delayed until long after roads at lower levels are open. It has sometimes required weeks to melt and break a way through. Then some bright mind conceived the idea of scattering black soil and dark coloured ashes over the snow surface. It worked beautifully: the snow went almost magically fast as compared with previous experience, and interference with traffic was greatly shortened." "Some bright mind" and "almost magically fast" may not be scientific, but they make excellent reading.

Snow, hurricanes and thunderstorms are discussed at some length, the opportunities for studying extreme cases of these phenomena being more frequent in America than in many other parts of the globe; the sections of the book devoted to them are instructive for meteorologists and laymen alike. The merit of the book as a popular instructor, however, lies in the clear explanation of present weather by reference to the past history of the air. The physical processes involved in the flow of warm air to colder latitudes and cold air to warmer latitudes, are analysed without presenting any technical difficulties.

Recent developments in meteorology are not omitted. Dr.

Brooks has something to say about " polar fronts," the making of long range forecasts based mainly on the state of the Arctic ice, the separation of electrical charges accompanying the splitting up of raindrops.

Dr. Brooks is occasionally dogmatic where the subject is still open to controversy, but if one is to be " popular" one must doubtless express only one point of view, and that with conviction : he says, for instance, " if a ' low ' goes by in too much of a hurry, it sometimes requires another immediately succeeding ' low ' to finish the job of establishing fair and much colder weather. A strong low pressure area may pass so rapidly through the region that there is neither time for much warm air to come north on its front, nor for much cold air to travel far south in its rear " ; and again, in an explanation of the sea breeze, he says : " The heated air (over the land) expands, and some of it spills over above the denser air over the water, lowering the pressure over the land and raising it over the water." Both may be true and aptly worded explanations of what happens, but the author gives a suggestion of finality to the theories he propounds which might lead an unsuspecting reader to think that they were as generally accepted by meteorologists as, say, the theory of the production of the normal solar halo.

Dr. Brooks has succeeded in writing an interesting book which should make a wide appeal to those who want to know something about meteorology but have previously hesitated lest the text book should prove too dry.

M. T. SPENCE.

Obituary

Captain Alfred Carpenter, D.S.O., R.N.—We record with deep regret the death of Captain Alfred Carpenter, D.S.O., R.N., retired, which occurred on April 30th at his residence at Sanderstead at the age of 77 years. His scientific tastes showed themselves early, and secured for him an appointment on the famous *Challenger* expedition. The associations then formed affected his whole future career, for his subsequent commands were in surveying ships, where scientific work is the primary consideration. But he saw much active war service as well. He was awarded the D.S.O. for his services in the Burmese war, being the first Naval Officer to receive that distinction. From 1884 to 1889 he was in charge of the Marine Survey of India.

As a meteorologist he did good work. We owe to him a number of interesting papers in the *Quarterly Journal of the Royal Meteorological Society*, mostly descriptions of remarkable tropical hurricanes, and in his later years he contributed a number of notes on observations of the green flash. He was a staunch friend of the Meteorological Office, to which he contri-

buted no fewer than twenty "excellent" logs, the majority from eastern seas, during his service afloat. His most active association with the Office did not come until after he had retired from active service. In 1901 the Office was asked by the London County Council to arrange for an inquiry into London fogs with a view to forecasting, if possible, the local incidence of these phenomena, and thus enabling more adequate provision to be made for coping with the loss and inconvenience which they cause. Captain Carpenter was invited by the Meteorological Council to take charge of the inquiry, and during the winter of 1901-02 he organised a network of observing stations among the Fire Stations in the Metropolis. His report on the observations was subsequently issued as an official publication of the Office. It was a matter of great regret to the Council that the state of his health prevented him from continuing the work during the following winter.

R. G. K. LEMPFERT.

News in Brief

We learn with regret of the death at Nice, at the age of 72 years, of M. Joseph Vallot, Director of the Mont Blanc Observatory. It will be remembered* that M. Vallot founded the first Observatory on the mountain in 1890, and replaced it by the present one in 1898. He made no less than 35 expeditions to the summit and to his observatory.

We are informed that Colonel Enrique Meseguer has been appointed Director of the Spanish Meteorological Service in succession to Colonel J. Cruz-Condé.

On Friday, May 8th, Sir Gilbert T. Walker, C.S.I., F.R.S., delivered a lecture at the Royal Society of Arts on *Indian Meteorology*.

The balloon sent up at Kew Observatory on the occasion of the visit of the Royal Meteorological Society, fell near Godalming after rising to a height of 12½ kilometres (42,000 feet). The stratosphere was reached at 11·1 kilometres.

Erratum.

February, 1925, page 25, line 22, *for* "Melbourne" *read* "Roebourne."

* *Meteorological Magazine*, 59 (1924), 37.

The Weather of April, 1925

THE weather during April was generally changeable and showery, with many sunny periods and a rainfall above normal in most districts. Snow fell in several parts of Scotland during the first few days of the month, and lay more than 6 in. deep in Edinburgh on the 1st. A ridge of high pressure moved across England on the 3rd, and was associated with sharp frost on the morning of the 4th, when a grass minimum temperature of 11° F. was recorded at Oundle in Northamptonshire. Pressure subsequently remained low near Ireland for many days, giving southerly winds, moderate rain and warmer weather. Maximum readings of 66° F. were recorded at S. Farnborough on the 8th and Worksop on the 12th. Local thunderstorms were experienced during this period, and fog or mist occurred in the eastern and southern districts of Great Britain on several mornings. On the 13th there was a change to westerly winds and a deep depression passing across the north of Scotland was associated with high winds and gales in many parts on the 15th and 16th. Gusts of over 60 m.p.h. were reported from several places, and on the morning of the 16th gusts of 80 m.p.h. (83 m.p.h. at Fleetwood) occurred on the north-west coasts of England, while near the east coast the R.33 was torn from its moorings at Pulham. Between the 19th and 21st a ridge of high pressure passed across the British Isles, and fair or fine weather prevailed. Over 13 hours bright sunshine were recorded in parts of Ireland on the 19th and 20th, and screen minimum temperatures below 32° F. occurred in many places. High north-east winds and gales were experienced in the Straits of Dover early in the morning of the 21st. As the high pressure ridge moved southwards a depression developed rapidly off the Hebrides on the 22nd, and high south-westerly winds occurred in exposed places in the north and west, with heavy rain in northern England. During the last week the weather continued generally unsettled, though with many bright periods. Local thunderstorms were of frequent occurrence, especially in the south-eastern districts.

The total rainfall for the month was more than twice the normal in parts of south Scotland and at a few places in Sussex and Surrey, e.g. : 249 per cent. of the normal fell at Biggar (Lanarkshire) and 237 per cent. at Patching Farm (Sussex). Only in a few districts in the west of England was the rainfall less than normal.

Pressure was below normal over the northern part of the North Atlantic and over western Europe (except Spain and Portugal), the deficit exceeding 5 mb. over the north of Scotland, the Faroes, the greater part of Iceland, and the coast of Norway. Over the central and southern parts of the North Atlantic and over the

Iberian Peninsula pressure was slightly above normal. This distribution favoured south-westerly winds over western Europe, and temperatures in Scandinavia and at Spitsbergen were several degrees above normal, while rainfall generally showed a slight excess. In Sweden, temperature was about 4° F. above normal except in the central mountainous regions where it was 3° F. below normal. Heavy rains occurred generally between the 14th and 17th, but the total precipitation for the month was normal. In Norway a heavy landslip occurred near the mouth of the river Glommen on the 17th and 18th. This destroyed much farming land, and formed so large a barrier in the river that many of the steamers at Sannesund had to leave there with little or no cargo. Early in the month three members of a party of tourists were killed and twenty-three injured by lightning at Königstein, near Dresden.

In Canada, the Assiniboine river was in flood at the beginning of the month, and dynamite was being used to break up the huge ice jambs. A tornado passed within a few miles of Miami, Florida, on April 5th. Three people were killed, and much damage done to property in the vicinity of its path. On the 23rd unusual conditions prevailed in the United States: heavy snowstorms occurred in Montana, the snowfall amounting to 17 in. at Butte, while very high temperatures for the time of year occurred in the eastern regions, a maximum reading of 93° F. being recorded at Washington (D.C.), and one of 92° F. at Chattanooga (Tennessee). On the same day rain fell in northern Texas, breaking the drought in that region.

The total rainfall for the month in Australia was considerably below normal, except in the extreme north where 15·25 in. or 274 per cent. of the normal fell in the northern part of Cape York Peninsula. In many of the more southerly districts of Queensland there was no rain at all throughout the month.

The special message from Brazil states that the rainfall was plentiful in the northern regions, being 54 mm. above normal, but scarce in the central and southern regions, where it was 58 mm. and 20 mm. below normal respectively. Numerous anticyclones of medium intensity passed across the country. The condition of the crops is generally good. Pressure at Rio de Janeiro was 1·1 mb. below normal, and temperature 0·7° F. above normal.

Rainfall April, 1925—General Distribution

England and Wales ..	133	per cent. of the average 1881-1915.
Scotland	164	
Ireland	154	
British Isles	145	

Rainfall: April, 1925: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square.....	1·63	41	106	*War.*	Birminghm, Edgbaston	2·17	55	125
Sur .	Reigate, Hartswood...	3·19	81	206	*Leics*	Thornton Reservoir ..	1·74	44	102
Kent.	Tenterden, View Tower	2·46	63	152	,, .	Belvoir Castle.....	1·36	35	89
,, .	Folkestone, Boro. San.	3·47	88	...	*Rut .*	Ridlington.....	1·68	43	...
,, .	Broadstairs, St Peter's	2·03	52	147	*Linc.*	Boston, Skirbeck	1·93	49	143
,, .	Sevenoaks, Speldhurst.	2·65	67	...	,, .	Lincoln, Sessions House	1·55	39	112
Sus .	Patching Farm.....	4·14	105	237	,, .	Skegness, Estate Office.	1·91	49	143
,, .	Brighton, Old Steyne .	...	..	...	,, .	Louth, Westgate	2·29	58	137
,, .	Tottingworth Park....	3·33	85	180	,, .	Brigg	2·18	55	139
Hants	Ventnor, Roy.Nat.Hos.	2·65	67	158	*Notts.*	Worksop, Hodsock....	1·84	47	125
,, .	Fordingbridge, Oaklnds	2·56	65	140	*Derby*	Mickleover, Clyde Ho..	1·82	46	105
,, .	Ovington Rectory	3·38	86	179	,, .	Buxton, Devon. Hos...	3·78	96	129
,, .	Sherborne St. John Rec.	2·48	63	140	*Ches.*	Runcorn, Weston Pt...	1·75	44	101
Berks	Wellington College...	1·87	47	116	,, ..	Nantwich, Dorfold Hall	1·39	35	...
,, .	Newbury, Greenham..	2·32	59	127	*Lancs*	Manchester, Whit. Pk.	2·01	51	105
Herts.	Bennington House....	...	..	...	,, ..	Stonyhurst College....	2·71	69	100
Bucks	High Wycombe	1·90	48	121	,, ..	Southport, Hesketh...	1·67	43	90
Oxf..	Oxford, Mag. College..	2·40	61	156	,, ..	Lancaster, Strathspey.	2·51	64	...
Nor .	Pitsford, Sedgebrook..	1·81	46	118	*Yorks*	Sedbergh, Akay	5·97	152	184
,, .	Eye, Northolm.....	1·13	29	...	,, .	Wath-upon-Dearne ...	2·70	69	171
Beds.	Woburn, Crawley Mill.	1·59	41	106	,, .	Bradford, Lister Pk...	2·79	71	139
Cam.	Cambridge, Bot. Gdns.	1·72	44	126	,, .	Wetherby, Ribston H..	3·15	80	179
Essex	Chelmsford, CountyLab	1·21	31	95	,, .	Hull, Pearson Park ...	2·12	54	136
,, .	Lexden, Hill House...	1·75	44	...	,, .	Holme-on-Spalding ...	2·47	63	...
Suff .	Hawkedon Rectory ...	2·75	70	179	,, .	West Witton, Ivy Ho..	3·76	95	...
,, .	Haughley House.....	2·33	59	...	,, .	Felixkirk, Mt. St. John	2·72	69	163
Norf.	Beccles, Geldeston....	2·47	63	168	,, .	Pickering, Hungate ...	2·57	65	...
,, .	Norwich, Eaton	2·50	63	146	,, .	Scarborough.....	2·40	61	154
,, .	Blakeney	2·45	62	191	,, .	Middlesbrough	2·04	52	149
,, .	Swaffham	2·19	56	148	,, .	Baldersdale, Hury Res.	4·08	104	174
Wilts.	Devizes, Highclere....	1·97	50	104	*Durh.*	Ushaw College	3·24	82	171
,, .	Bishops Cannings	2·11	54	104	*Nor .*	Newcastle, Town Moor.	2·92	74	178
Dor .	Evershot, Melbury Ho.	2·71	69	115	,, .	Bellingham, Highgreen	3·43	87	...
,, .	Weymouth, Westham..	2·29	58	138	,, .	Lilburn Tower Gdns...	3·34	85	...
,, .	Shaftesbury, Abbey Ho.	3·14	80	147	*Cumb*	Geltsdale.....	4·84	123	...
Devon	Plymouth, The Hoe...	1·90	48	86	,, .	Carlisle, Scaleby Hall .	3·35	85	172
,, .	Polapit Tamar	3·32	84	142	,, .	Seathwaite M.....	16·00	406	216
,, .	Ashburton, Druid Ho..	3·89	99	128	*Glam.*	Cardiff, Ely P. Stn.....	2·78	71	110
,, .	Cullompton	3·54	90	156	,, .	Treherbert, Tynywaun	6·05	154	...
,, .	Sidmouth, Sidmount ..	3·09	79	145	*Carm*	Carmarthen Friary....	3·18	81	116
,, .	Filleigh, Castle Hill ...	3·89	99	...	,, .	Llanwrda, Dolaucothy.	4·23	107	128
,, .	Barnstaple, N.Dev.Ath.	2·95	75	139	*Pemb*	Haverfordwest, School	2·69	68	103
Corn.	Redruth, Trewirgie ...	3·59	91	125	*Card.*	Gogerddan.....	2·58	65	99
,, .	Penzance, Morrab Gdn.	2·55	65	105	,, .	Cardigan, County Sch. .	2·35	60	...
,, .	St. Austell, Trevarna..	4·08	104	145	*Brec .*	Crickhowell, Talymaes	3·50	89	...
Soms	Chewton Mendip	3·41	87	115	*Rad .*	Birm.W.W.Tyrmynydd	5·20	132	141
,, .	Street, Hind Hayes ...	2·37	60	...	*Mont.*	Lake Vyrnwy	3·22	82	107
Glos..	Clifton College	1·73	44	80	*Denb.*	Llangynhafal	2·28	58	...
,, .	Cirencester	2·04	52	106	*Mer .*	Dolgelly, Bryntirion..	4·24	108	116
Here.	Ross, Birchlea	1·75	44	92	*Carn.*	Llandudno	1·31	33	72
,, .	Ledbury, Underdown.	2·14	54	118	,, .	Snowdon, L. Llydaw 9	7·87	200	...
Salop	Church Stretton.....	2·42	61	144	*Ang .*	Holyhead, Salt Island.	1·70	43	82
,, .	Shifnal, Hatton Grange	1·64	42	98	,, .	Lligwy	2·20	56	...
Staff.	Tean, The Heath Ho...	1·77	45	89	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	2·22	56	146		Douglas, Boro' Cem...	3·25	83	132
,, .	Blockley, Upton Wold.	2·48	63	128	*Guernsey*				
War.	Farnborough.....	2·63	67	134		St. Peter P't, Grange Rd	2·85	72	142

Rainfall: April, 1925: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm	Per-cent. of Av.
Wigt.	Stoneykirk, Ardwell Ho	2·88	73	137	*Suth.*	Loch More, Achfary...	5·31	135	109
,, .	Pt. William, Monreith .	3·16	80	...	*Caith*	Wick	1·64	42	82
Kirk.	Carsphairn, Shiel.	8·20	208	...	*Ork .*	Pomona, Deerness	2·35	60	113
,, .	Dumfries, Cargen.....	4·84	123	181	*Shet .*	Lerwick	2·89	73	127
Dum	Drumlanrig	5·62	143	228					
Roxb	Branxholme	3·93	100	208	*Cork.*	Caheragh Rectory	5·77	147	...
Selk .	Ettrick Manse.....	6·65	169	...	,, ..	Dunmanway Rectory.	5·59	142	135
Berk.	Marchmont House	3·39	86	168	,, ..	Ballinacurra	4·78	121	185
Hadd	North Berwick Res....	2·24	57	160	,, ..	Glanmire, Lota Lo. ...	5·54	141	198
Midl	Edinburgh, Roy. Obs..	2·89	73	211	*Kerry*	Valencia Obsy.	5·67	144	154
Lan	Biggar	4·31	109	249	,, .	Gearahameen	9·00	229	...
Ayr .	Kilmarnock, Agric. C..	3·98	101	193	,, .	Killarney Asylum.....	5·74	146	173
,, .	Girvan, Pinmore.....	4·50	114	152	,, .	Darrynane Abbey	5·29	134	154
Renf.	Glasgow, Queen's Pk..	4·03	102	205	*Wat .*	Waterford, Brook Lo..	4·07	103	160
,, .	Greenock, Prospect H..	7·24	184	199	*Tip .*	Nenagh, Cas. Lough...	5·44	138	217
Bute.	Rothesay, Ardencraig.	5·62	143	189	,, .	Tipperary	4·74	120	...
,, .	Dougarie Lodge	4·71	120	...	,, .	Cashel, Ballinamona ..	4·63	118	185
Arg .	Ardgour House	8·64	219	...	*Lim .*	Foynes, Coolnanes	3·31	84	136
,, .	Manse of Glenorchy..	7·09	180	...	,, .	Castleconnell Rec.	5·55	141	...
,, .	Oban	4·78	121	...	*Clare*	Inagh, Mount Callan ..	5·36	136	...
,, .	Poltalloch	5·25	133	179	,, .	Broadford, Hurdlest'n.	5·27	134	...
,, .	Inveraray Castle.....	...	..	...	*Wexf*	Newtownbarry	4·36	111	...
,, .	Islay, Eallabus.....	5·93	151	207	,, .	Gorey, Courtown Ho...	2·66	68	121
,, .	Mull, Benmore	9·80	249	...	*Kilk.*	Kilkenny Castle	2·99	76	137
Kinr.	Loch Leven Sluice	4·09	104	213	*Wic .*	Rathnew, Clonmannon	2·65	67	...
Perth	Loch Dhu	8·90	226	188	*Carl .*	Hacketstown Rectory .	3·69	94	139
,, ..	Balquhidder, Stronvar.	6·84	174	153	*QCo..*	Blandsfort House.....	3·52	89	135
,, ..	Crieff, Strathearn Hyd.	4·40	112	201	,,	Mountmellick	4·69	119	...
,, ..	Blair Castle Gardens ..	2·75	70	130	*KCo.*	Birr Castle.....	3·80	97	177
,, .	Coupar Angus School..	3·75	95	226	*Dubl.*	Dublin, FitzWm. Sq...	2·46	63	129
Forf.	Dundee, E. Necropolis.	2·87	73	169	,, .	Balbriggan, Ardgillan	2·14	54	108
,, .	Pearsie House.....	4·01	102	...	*Me'th*	Drogheda, Mornington	2·16	55	...
,, .	Montrose, Sunnyside..	2·85	72	157	,, .	Kells, Headfort.....	2·87	73	115
Aber.	Braemar Bank	3·50	89	152	*W.M*	Mullingar, Belvedere .	3·81	97	161
,, .	Logie Coldstone Sch. ..	2·33	59	116	*Long*	Castle Forbes Gdns....	3·81	97	159
,, .	Aberdeen, Cranford Ho	...	..	...	*Gal .*	Ballynahinch Castle ..	5·01	127	142
,, .	Fyvie Castle	2·51	64	...	*Mayo*	Mallaranny.....	6·00	152	...
Mor .	Gordon Castle.....	1·92	49	110	,, .	Westport House.....	4·49	114	166
,,	Grantown-on-Spey....	2·51	64	127	,, .	Delphi Lodge	8·22	209	...
Na .	Nairn, Delnies.....	1·64	42	109	*Sligo*	Markree Obsy.	4·27	109	162
Inv..	Ben Alder Lodge	5·25	133	...	*Cav'n*	Belturbet, Cloverhill..	3·98	101	174
,, .	Kingussie, The Birches	2·94	75	...	*Ferm*	Enniskillen, Portora ..	4·29	109	...
,, .	Loch Quoich, Loan....	10·00	254	...	*Arm.*	Armagh Obsy.	2·82	71	134
,, .	Glenquoich	10·27	261	158	*Down*	Warrenpoint	2·50	63	...
,, .	Inverness, Culduthel R.	1·78	45	...	,, .	Seaforde	3·78	96	144
,, .	Arisaig, Faire-na-Squir	...	..	...	,, .	Donaghadee, C. Stn...	2·83	72	143
,, .	Fort William.....	8·32	211	188	,, .	Banbridge, Milltown .	2·47	63	120
,, .	Skye, Dunvegan.....	4·90	125	...	*Antr.*	Belfast, Cavehill Rd. .	4·04	103	...
,, .	Barra, Castlebay	2·67	68	...	,, .	Glenarm Castle.....	5·17	131	...
R&C	Alness, Ardross Cas. ..	3·15	80	130	,, .	Ballymena, Harryville	4·26	108	161
,, .	Ullapool.....	4·30	109	...	*Lon .*	Londonderry, Creggan	4·86	123	189
,, .	Torridon, Bendamph..	7·00	178	134	*Tyr .*	Donaghmore	4·27	109	...
,, .	Achnashellach	6·90	175	...	,, .	Omagh, Edenfel	4·14	105	157
,, .	Stornoway	3·79	96	125	*Don .*	Malin Head	3·87	98	196
Suth.	Lairg	2·85	72	...	,, .	Rathmullen.....	4·51	115	...
,, .	Tongue Manse.....	3·09	79	118	,, .	Dunfanaghy	4·34	110	161
,, .	Melvich School.....	2·08	53	90	,, .	Killybegs, Rockmount.	4·36	111	121

Climatological Table for the British Empire, November, 1924

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1018·4	+ 3·8	60	27	51·1	41·5	46·3	+ 2·3	44·5	85	7·6	58	+ 2	12	1·3	15
Gibraltar	1017·9	— 0·1	77	46	64·9	53·6	59·3	— 1·2	55·7	77	5·9	161	— 1	16	...	...
Malta	1017·0	+ 1·3	76	52	68·4	60·1	64·3	+ 1·3	59·0	77	4·4	55	— 26	12	6·2	61
Sierra Leone	1013·1	+ 2·3	89	67	86·5	71·0	78·7	— 2·5	75·9	78	6·1	140	+ 6	14	...	...
Lagos, Nigeria	1010·0	— 0·8	90	71	87·9	75·9	81·9	+ 0·6	78·7	78	4·8	21	— 45	6	...	...
Kaduna, Nigeria	1014·2	+ 2·9	94	64	90·6	69·9	80·3	+ 4·1	71·9	70	1·0	0	— 1	0	...	...
Zomba, Nyasaland	1009·1	+ 0·1	96	61	90·3	67·4	78·9	+ 3·8	...	76	4·5	18	—124	8	...	...
Salisbury, Rhodesia	1009·1	— 0·5	92	55	81·9	60·2	71·1	+ 0·2	62·2	56	5·4	110	+ 18	16	...	...
Cape Town	1017·2	+ 1·5	88	42	70·9	54·7	62·8	— 0·3	58·9	66	4·5	38	+ 11	12	...	...
Johannesburg	1013·0	+ 0·2	82	43	72·0	53·1	62·5	— 0·9	54·5	67	6·1	104	— 4	14	7·1	53
Mauritius	1015·9	— 0·2	86	58	82·4	65·8	74·1	— 1·4	68·0	72	4·9	36	— 4	9	9·4	72
Bloemfontein	...	...	93	40	78·1	52·4	65·3	— 3·1	56·3	55	4·8	50	— 8	9	...	...
Calcutta, Alipore Obsy.	1012·5	— 0·8	87	62	80·1	68·1	74·1	+ 1·0	68·0	84	5·4	47	+ 33	5*	...	...
Bombay	1010·6	— 1·3	90	69	86·6	72·4	79·5	— 0·8	68·4	69	1·9	10	0	1*	...	...
Madras	1009·4	— 1·9	89	67	84·1	72·5	78·3	— 0·4	73·6	84	8·1	409	+ 84	13*	...	...
Colombo, Ceylon	1009·3	— 0·8	87	70	85·7	73·9	79·8	— 0·5	76·6	72	7·1	244	— 63	16	6·4	54
Hong Kong	1018·4	+ 0·8	81	49	73·4	63·8	68·6	— 1·1	59·6	57	3·2	0	— 36	0	8·5	77
Sandakan	...	...	89	73	87·0	74·6	80·8	— 0·2	76·4	81	...	650	+277	19	...	...
Sydney	1012·6	— 1·1	94	51	72·9	58·3	65·6	— 1·4	59·8	70	6·0	78	+ 5	14	6·8	49
Melbourne	1011·7	— 2·5	87	45	69·6	52·9	61·3	0·0	56·2	65	6·6	108	+ 52	16	5·7	41
Adelaide	1013·2	— 1·9	101	42	76·5	55·0	65·7	— 1·2	56·4	49	5·8	48	+ 19	12	8·1	58
Perth, W. Australia	1014·4	— 0·9	94	48	74·7	55·8	65·3	— 0·5	58·1	63	4·9	66	+ 46	13	8·0	58
Coolgardie	1011·7	— 1·4	109	47	85·4	55·8	70·6	— 0·2	57·7	30	3·3	7	— 10	2	...	...
Brisbane	1013·3	— 1·0	91	61	81·0	65·3	73·1	— 0·5	67·3	65	5·2	160	+ 68	14	7·5	55
Hobart, Tasmania	1008·6	— 0·8	78	40	64·6	48·8	56·7	— 0·5	51·2	65	7·1	82	+ 18	21	7·1	49
Wellington, N.Z.	1016·7	+ 5·1	73	43	64·6	52·9	58·7	+ 1·9	53·9	72	6·4	74	— 14	12	7·2	50
Suva, Fiji	1011·3	+ 0·2	85	67	83·4	71·9	77·7	+ 0·5	74·6	80	5·5	233	— 9	16	...	...
Apia, Samoa	1011·1	+ 1·6	88	72	81·1	75·6	78·4	— 0·3	76·8	77	5·3	260	+ 24	17	7·1	56
Kingston, Jamaica	1011·3	— 1·1	90	66	85·5	71·0	78·3	— 1·0	73·3	77	8·1	264	+184	14	...	...
Grenada, W.I.	1011·9	+ 1·3	89	70	84·0	74·7	79·3	0·0	75·5	81	5·2	250	+ 42	22	...	...
Toronto	1015·9	— 0·9	68	13	46·2	31·8	39·0	+ 2·7	34·1	76	6·0	24	— 51	9	3·7	38
Winnipeg	1015·8	— 0·9	41	— 5	26·0	14·1	20·1	— 0·7	...	...	6·3	29	+ 5	15	2·4	26
St. John, N.B.	1014·2	+ 0·3	57	14	44·3	32·8	38·5	+ 1·8	36·1	83	6·7	77	— 35	11	3·2	34
Victoria, B.C.	1018·1	+ 2·6	55	31	47·1	39·7	43·4	— 1·0	41·3	89	7·5	107	— 57	21	2·7	29

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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Long Period Variations in the Rainfall of Great Britain

By C. E. P. BROOKS, M.Sc.

THE earliest known measurements of rainfall in this country date from 1677, in which year the record at Townley, near Burnley in Lancashire, commenced. This record continued with intermissions until 1704. Meanwhile, in 1697, a record was commenced at Upminster, Essex, which continued until 1716. From this date there was a gap of nine years, after which records began at Southwick, near Oundle, in 1726, and at Plymouth in 1727. Both these are overlapped by a long record from Lyndon, Rutland, commencing in 1737, and from that date there is no difficulty in carrying on the story. The records from 1726 onwards were collated by G. J. Symons, who published a well-known table of the annual variation in *British Rainfall* for 1870, but, owing to the gap, the earlier records could not be compared directly with this series, while the Plymouth record came to light after Symons had completed his calculations. The method employed by Symons was to calculate for each station the average for the period over which its records extended, and to express the rainfall for each year as a percentage of that average. The various series were then reduced to a common basis by means of corrections deduced from the years during which pairs of records overlapped. This process is sound if the records are truly homogeneous and if the stations are close together and overlap by a sufficient number of years, but it becomes hazardous

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when it is applied several times to isolated records and the overlapping periods are short. For example, the reduction from the average at Southwick to that at Lyndon is based on an overlap of only three years, of which 1737 was much wetter at Lyndon than at Southwick, while in 1738 and 1739 Southwick was slightly wetter than Lyndon. Hence some sort of a check seems to be necessary, and this was provided by expressing the early figures as percentages of the normal for the period 1881 to 1915, and comparing these figures with the percentages obtained by Symons. The results show very close agreement :—

		Percentages given by Symons.	Percentage of 1881-1915.
1726-1736	Southwick	99	97
1740-1760	Lyndon	78	78
1727-1752	Plymouth	83	84

This table is a remarkable testimony to the accuracy and judgment of the reductions carried out by Symons. It is reassuring on another point also. We know nothing as to the construction and exposure of these old gauges, but if they had recorded less than the correct amounts, the figures in the second column of percentages would have been lower than those in the first. The figures may be accepted as reasonably accurate, and this encourages us to accept also the figures for Townley and Upminster. These cannot be reduced to the present day normal by Symons' method, so that they have been compared directly with estimated normals for the period 1881 to 1915.

In this way we obtain the following figures of rainfall in percentage of present normal :—

1677 to 1686	Townley	89 per cent.
1689 to 1693	Townley	90 ,,
1697 to 1703	Townley and Upminister ..	91 ,,
1704 to 1716	Upminster	93 ,,
1726 to 1730	Southwick and Plymouth ..	100 ,,

The means for subsequent decades are shown in Table I. In this table the period 1731-1750 is a combination of the means given by Symons with the Plymouth data. From 1751 to 1868 the means given by Symons have been employed directly, and from 1869 to 1920 the means published in *British Rainfall*, 1923, have been employed.

Before the year 1677 no rainfall measurements are available. Estimates of the " wetness " could perhaps be obtained from various old weather journals, such as that of the Rev. William Merle, kept at Driby, Lincolnshire, from 1337 to 1344, and translated by G. J. Symons, but even this journal is not a true

diary, and for only a few months can the actual number of days with rain be counted. The general impression given by Merle's journal is that the weather was not greatly different from English weather at the present day, but it was not easy to derive any quantitative estimate from it. It is unfortunate that we have in England no striking annual phenomenon like the Nile Flood, which has been recorded annually, with only a few breaks, for fourteen centuries. We have to make the best of the records

TABLE 1. RAINFALL MEANS BY DECADES.

Decade.	Percentage of 1881-1915 normal.	Decade.	Percentage of 1881-1915 normal.	Decade.	Percentage of 1881-1915 normal.
1731-40	84	1801-10	89	1861-70	98
1741-50	75	1811-20	98	1871-80	108
1751-60	86	1821-30	105	1881-90	99
1761-70	95	1831-40	99	1891-00	99
1771-80	100	1841-50	103	1901-10	99
1781-90	95	1851-60	98	1911-20	105
1791-00	97				

of the old chroniclers, who wrote down in their annals the noteworthy phenomena—floods, droughts and storms—which they witnessed or heard of. These annals have been studied by E. J. Lowe,* G. J. Symons† and, recently, by Sir Richard Gregory,‡ and from this material Table 2 has been prepared. Under the heading (*a*) Storms and Floods, are given the numbers of years in each half-century for which great wind-storms, heavy rains or extensive floods have been recorded ; sporadic summer thunderstorms have been omitted as far as possible. The numbers of droughts under heading (*b*) have been counted directly from Symons' work. The column headed " wetness " gives the percentage of the total records ($a + b$) which is formed by (a).

All such records are, of course, comparative. Suppose that after some centuries, during which the rainfall had been on the whole low and the storminess slight, there was a rather sudden change to heavy rainfall and great storminess, which persisted

* Natural phenomena and chronology of the seasons, London, 1870.
† Historic droughts, *British Rainfall*, 1887, p. 22.
‡ British climate in historic times. Geog. Teacher, Vol. 12, 1924.

for several more centuries. By the end of the first period dry fine weather would be accepted as the normal condition, hence when the change of climate set in, the chronicles would contain numerous references to floods and storms. After one or two generations of the new climatic regime, however, stormy weather would be accepted as the normal, and the number of references to floods and storms would again fall off. Evidently Table 2 can only be used in a qualitative sense.

The most remarkable fluctuation in the whole period, which occurred about the middle of the eleventh century, appears to have been just such a change in the general level of climate from calm and dry to stormy and wet. This change was not confined

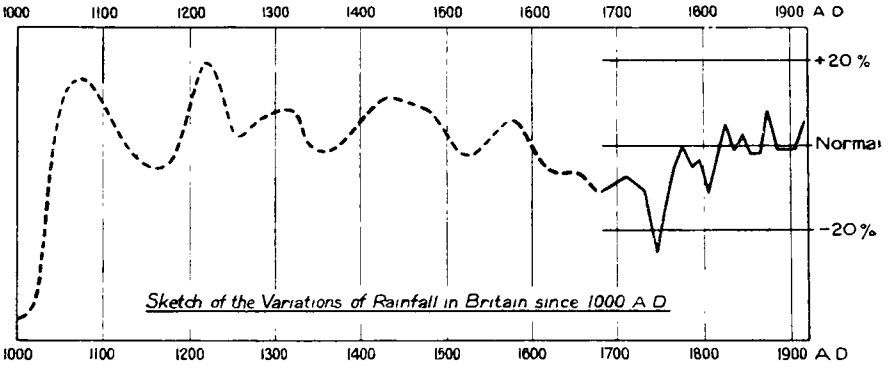
TABLE 2. FREQUENCY OF STORMS, FLOODS AND DROUGHTS.

Years.	(*a*) Storms and Floods.	(*b*) Droughts.	"Wetness."	Years.	(*a*) Storms and Floods.	(*b*) Droughts.	"Wetness."
1001-1050	2	3	40	1401-1450	3	1	75
1051-1100	9	1	90	1451-1500	3	6	33
1101-1150	4	10	29	1501-1550	2	6	25
1151-1200	1	3	25	1551-1600	10	12	45
1201-1250	8	7	53	1601-1650	8	15	35
1251-1300	8	13	35	1651-1700	20	22	48
1301-1350	3	7	30	1701-1750	17	29	37
1351-1400	3	7	30				

to Britain ; it is shown also in the Belgian records and in those for Europe in general. About this date the Norse sailors began to experience difficulty with ice on their way to and from Greenland, and the first record of severe ice in Danish waters was in 1048. Going further afield, we find a rapid rise in the level of the Nile about the same date. It seems that we are dealing here with a change of climate which was very extensive, if not world-wide.

The first half of the twelfth century gives us ten records of drought, and there appears no doubt that it was drier than 1051 to 1100, though probably not so dry as 1001 to 1050. The second half of the twelfth century has yielded few weather remarks, and was probably quiet and rather dry. In the first half of the thirteenth century we enter another period of great storminess and repeated floods. The culmination of this period was probably in the winter of 1218 to 1219, when the sea invaded

parts of Holland and Friesland, and gave the coast its present form. By contrast, the remainder of this century appeared quiet and dry; it includes a very severe drought in 1252. The oft-quoted storminess of the first half of the fourteenth century is not shown in Table 2. In Belgium and in central Europe this period appears to have been rather wet and stormy, but not phenomenal. According to E. Antevs it was cold and stormy in Sweden, while Ellsworth Huntington states that the levels of the Caspian and of Lake Lop-Nor, in central Asia, were high; on the other hand, the level of the Nile was rather low. Probably the tracks of depressions lay rather far north in western Europe, but then turned south-eastward into Russia, and crossed Asia in unusually low latitudes. The records of the period 1401-1450 in Britain are too few to be decisive, but the records from Belgium and the levels of the Caspian and Nile all point to a rather high rainfall during this half-century. After that date the fluctuations appear to have been less violent; there are indications of a maximum in 1551 to 1600 which is supported by the records from Belgium.



In the accompanying figure an attempt has been made at a graphical representation of the rainfall since 1000 A.D. The continuous curve at the right-hand end of the diagram is based on actual measurements, while the broken line has been sketched in from the records of storms, floods and droughts referred to above. The latter has, of course, no pretensions to quantitative accuracy, but is intended merely to suggest the probable nature of the variations from one half-century to another, and for this reason the horizontal lines indicating the scale are confined to the right hand end of the diagram, for which actual rainfall figures are available.

The Times states that the Davos Research Institute is arranging a Climatological Congress to be held there from August 17th to 22nd (see page V.).

OFFICIAL NOTICE

ADVANTAGE has been taken of the transfers of staff arising from the retirement of Dr. Chree (which was reported in our last issue) to regroup the work of the divisions housed at the Office at South Kensington. The supervision of the work of all the climatological stations, including the rainfall stations and the preparation of the serial statistical publications, the *Weekly Weather Report*, the *Monthly Weather Report* and *British Rainfall* will in future be undertaken by one division, which will be known as the British Climatology Division, while the task of dealing with the climatology of the world as a whole, including therein the supervision of the Library of the Office and the preparation of the *Réseau Mondial*, will be allotted to a separate division to which the name General Climatology Division has been assigned.

Mr. R. Corless will be in charge of the British Climatology Division, and Mr. C. E. P. Brooks, who has been promoted to the grade of Superintendent, will take charge of the General Climatology Division. Mr. Brooks will also act as Editor of this Magazine.

OFFICIAL PUBLICATIONS

The following publications have recently been issued :—

GEOPHYSICAL MEMOIRS.

No. 23. *The Climatology of Glasgow*, by L. Becker, Ph.D., Professor of Astronomy in the University of Glasgow. (No. 254c.)

This treatise is by way of being a model presentation of local climatology. The purpose of such a study is to provide answers to all the questions which may reasonably be anticipated as to the average weather experienced in any place, from the " man in the street," from the doctor, or from the meteorologist. Since questions are legion, they can only be answered by a variety of tables, hence the apparent disproportion between text and tabular matter. The statistics deal with barometric pressure, temperature, humidity, sunshine, cloudiness, visibility, and wind over a period of 50 years, and include monthly and five-day normals and serial values in standard form, and, in addition, a number of tables of special interest not usually found in works of this type. As examples of the latter we may quote : numbers of periods of warm weather and of frosty weather : frequencies of wet forenoons and afternoons at different times of the year : direction and velocity of the strongest gales.

The memoir is illustrated by photographs showing the exposures of the instruments, and by plates showing the annual and secular variations of the different meteorological elements.

No. 24. *The Distribution of Thunderstorms over the Globe.* By C. E. P. Brooks, M.Sc. (No. 254*d*.)

The frequency of thunder in various parts of the world is an important element in investigations relating to atmospheric electricity, and a knowledge of it is also useful in connection with the establishment of air routes. In this publication the monthly and annual frequency is discussed on the basis of records taken over a number of years at 3,265 stations, of which 2,680 are in Europe, together with a large number of observations on board ship. Maps are given showing the average frequency during the year, and also during October to March, and April to September. The monthly frequency in each of the continents and oceans and over the world as a whole is also shown in tabular form. It is considered that a station will probably record those thunderstorms which occur in a surrounding area of 200 square miles. If the earth's surface is considered as divided up into one million sections, each with an area of nearly two hundred square miles, there will be on the average sixteen thunderstorms in each area during a year, making a total of sixteen million thunderstorms a year, or 44,000 a day. If the average duration of a thunderstorm is an hour, there will be in progress at any one moment about 1,800 thunderstorms in different parts of the world. The diurnal variation and the variation in frequency with height are also briefly discussed.

Royal Meteorological Society

THE monthly meeting of this Society was held on Wednesday, May 20th, at 49, Cromwell Road, South Kensington, Mr. J. S. Dines, M.A., Vice-President, in the Chair.

Sir Gilbert Walker, C.S.I., F.R.S.—On Periodicity.

Since Schuster's classical papers on the periodogram, various modifications have been suggested, mainly with the purpose of shortening the calculations, and the value of these new methods under different conditions is discussed. Any series of numbers, such as a set of meteorological observations, can be resolved by these methods into a number of periodic terms. Hence it is necessary to have some criterion capable of application to a single series of data which will enable us to determine whether such periodic terms represent real recurrence of similar conditions after constant intervals, or whether they are merely due to the " accidental " run of the figures. This can be tested by comparing the amplitude with the greatest amplitude which may be expected from the analysis of a set of purely accidental numbers ; such a test is, however, not applicable to series involving sudden alterations of phase or " discontinuities," and

the chief contribution of the paper is a new criterion of the reality of periodicities applicable to such series. This may be made clear by the following example. A periodicity of 3 to $3\frac{1}{2}$ years is suspected in the barometric pressure at Port Darwin; accordingly correlation co-efficients are worked out between the data for each quarter and those for $1\frac{1}{2}$, $1\frac{3}{4}$, 2.....$4\frac{3}{4}$, 5 years later. The coefficients are negative when the interval is $1\frac{1}{2}$ to 2 years, and show maximum positive values of 0·24 and 0·26 when the intervals are 3 and $3\frac{1}{4}$ years. Since several of the coefficients exceed those to be expected from a chance distribution of the figures, the reality of a period of about 3·15 years is accepted. The last part of the paper is devoted to a criticism of the "variable periodicities" found by H. W. Clough.

H. Jeffreys, F.R.S.—On Fluid motions produced by differences of temperature and humidity.

It has been shown that the maintenance of a difference of temperature between parts of the same level surface in a fluid will necessarily maintain a permanent motion of the fluid, and that heating or cooling a fluid at an internal boundary will also maintain a permanent movement, however these boundaries may be situated. A corresponding theorem is true for the supply of new constituents instead of heat. This result appears to contradict a theorem given by Sandström and Bjerknes, to the effect that a permanent motion is possible only if the place where the heat is supplied is at a lower level than where it is removed; but the arguments of these authors involve an unstated assumption, which seems to be untrue. If this assumption is not made, their argument leads to the result that the fluid moving from the lower temperature to the higher is at a lower level than that moving towards the colder regions. These inferences have been verified by working out fully a special case of the motion of a fluid in a closed pipe, heated on one side and cooled on the other. Sandström's experiment, in which no motion was observed in a tank under conditions suited to the production of a circulation, is found to be capable of a dynamical explanation based on the slowness of conduction and the consequent confinement of the currents to narrow regions where they would be very difficult to observe. It appears unlikely that it will often be possible to proceed by analogy from this experiment to the dynamics of wind, for radiation and turbulence will always redistribute the heat in such a way as to produce general currents; but there may be some applications to ocean currents.

The late F. W. Harmer—Further remarks on the meteorological conditions of the Pleistocene Epoch with a note by C. E. P. Brooks, M.Sc.

The chief difference between the North Atlantic and North

Pacific Oceans is that the former is open to the north, while the latter is practically closed to the north, since Bering Strait is too narrow and shallow to allow the passage of an appreciable current. Hence in the Atlantic the Gulf Stream travels north-eastward into the Arctic Ocean, while in the Pacific the Japan current is forced to turn south-eastward along the coast of America. This difference causes differences in the pressure distribution; both oceanic and atmospheric circulation combine to give western Europe a more genial climate than the west of North America. From this comparison it is concluded that the closing of the Greenland-Europe channel would bring about changes in the oceanic and atmospheric circulations which would suffice to cause a glacial epoch in Europe. The diversion of the storm tracks and the consequent alteration in the direction of the prevalent winds are probably even more important than the changes in the currents. The second part of the paper dealt with the climatic changes in the Mediterranean region during the glacial period, and it is argued that the crowding together of the isotherms in southern Europe caused a great increase of storminess there, to which was due the torrential rains of which we have evidence.

A. H. R. Goldie, M.A.—Gustiness of wind in particular cases.

The author attempts to classify wind eddies passing over the sea, and deals particularly with examples from the anemograph records of Falmouth Observatory during periods of southwest winds. It was found that the time interval of the rise and fall of the anemograph pen and of the breaking of the waves on the shore approximated to seven seconds. A further investigation, carried out at Lerwick, was an attempt to ascertain the normal relation between "range of gusts" and "hourly mean wind" in the case of equatorial currents. The ratio appears to be about one-third, and is nearly independent of velocity.

Correspondence

To the Editor, *The Meteorological Magazine*

Are Winters Changing?

So much is heard now-a-days as to the change of the English climate in an ordinary life-time that a few facts dealing wholly with temperature may be of general interest. Greenwich observations have been used, being representative of England, and the period dealt with is from 1841, which is of sufficient length to cover the memory of any now living. Unless so stated the winter is taken as the six months from October to March.

In the following table the winter temperatures are grouped

into periods of 10 years. The mean is for the ten winters and the difference from the average is a comparison with the Greenwich mean temperatures for 60 years.

Date.	Mean.	Difference from average.	No. of Years above | below average.		Average number of nights with frost.
	°	°	+	−	
1841-51	42·3	−0·1	4	6	49
1851-61	41·8	−0·6	3	7	53
1861-71	42·5	+0·1	6	4	48
1871-81	42·0	−0·4	5	5	54
1881-91	41·7	−0·7	4	6	55
1891-1901	42·8	+0·4	5	5	44
1901-11	42·9	+0·5	8	2	43
1911-21	43·5	+1·1	8	2	38
1921-25 (4 winters only)	43·5	+1·1	3	1	37

The excess of temperature for the periods subsequent to 1901 and the decrease in the nights with frost seem at first sight to suggest some increase of temperature in recent times.

Sir Richard Gregory in a recent Presidential Address to the Geographical Association on "British Climate in Historic Times" gives a table of mean air temperatures at different seasons in London for 150 years, 1770 to 1919. In this table the Greenwich temperatures were used when available. The winter, in this case referring to December, January and February, is practically the only season showing an increase of temperature in recent years. The mean temperature for the 10 years 1910-19 is 40·6°, which is 2·2° above the average for the 150 years and it is the highest of all the 10 year means.

Dealing with the temperatures from 1841 the warmest winter was that of 1898-99, having a mean of 45·4°, or 3° above the average for 60 years, in the winter which has just closed, 1924-25, the mean temperature was 44·4°, 2° above the average for 60 years; there have in all been only 7 warmer winters since 1841. The occurrence of warm winters seems to have been most pronounced since 1902-3. In the 23 winters since that date 19 have been warmer than the normal and 4 of these were warmer than last winter. There have been only 6 winters with the mean temperature for the 6 months below 40°, and no such cold winter has occurred since 1890-91; the coldest winter was 1844-45 with a mean of 38·8°.

When there are such divergent facts as 20 days with frost in the winter of 1922-23 and as many as 63 in the winter of 1923-24 any theory of change in climate seems dangerous.

CHAS. HARDING.

2, *Bakewell Road, Eastbourne. April 6th*, 1925.

[The abnormal warmth of the winters from 1911 to 1920 was much more pronounced in central Europe than in the British Isles. See the *Meteorological Magazine*, 57 (1922), 203.—ED. *M.M.*]

Mammato-Cumulus Clouds

ON April 22nd, 1925, at Sale, about five miles south of Manchester, I noted a perfect example of mammato-cumulus clouds. The individual mammillations were very dark-grey in colour, each being marked off from its neighbours by a bright ring of light. The impression was that of a squadron of so many balloons. The clouds were very low (below the alto layer), and drifted slowly on a west-south-west wind (about force three at ground level). The rear boundary was sharply defined by a straight line. The mammillations were best visible in the south-east quadrant, being less distinct in the north-east quadrant. The sky was nine-tenths overcast. The clouds in the western sky were nondescript. The mammillated clouds were first seen by me at 18 h. 40 m. (G.M.T.), but evidently they must have been visible earlier. By 19 h., they had drifted out of view. There was no thunderstorm (a slight thunderstorm to the south-south-east of Sale occurred at 16 h. 15 m. on April 23rd, the day after the above observation).

An examination of the Whitworth Observatory (Manchester) barogram, showed that air pressure had been falling steadily for some hours before my observation. The mammato clouds were also noticed independently at Urmston, a few miles north-west of Sale, by an individual with no meteorological knowledge. I can only remember two personal observations of mammato-cumulus during the last six years. The observation reported above was one of the most beautiful meteorological phenomena I have yet seen.

In view of Mr. Kidson's letter,* and of the correspondence in *Nature*, to which he refers, one may hope that one of our cloud experts will discuss the subject at greater length. In any event, the section on mammato-cumulus in the *Meteorological Glossary* (Fourth Issue, 1918, *pp.* 190-191), would seem to require revision, as the description appears to limit the cloud to Mr. Kidson's second type.

RAYMOND WHITEHEAD.

The University, Manchester. April 24th, 1925.

THE Institution of Water Engineers have awarded an Institution premium to Mr. J. Glasspoole, Ph.D., for his paper on "Fluctuations of Annual Rainfall: three driest consecutive years," read at the meeting on December 4th, 1924.

* In the *Meteorological Magazine*, 60 (1925), 39-40.

NOTES AND QUERIES

The Parkin Prize

THE following notice has been received from Dr. J. S. Fowler, Secretary of the Royal College of Physicians of Edinburgh :—

In terms of the Bequest made to the Royal College of Physicians of Edinburgh by the late Dr. John Parkin, Fellow of the College, a Prize is offered for the best Essay on certain subjects connected with Medicine.

The Subject of the Essay for the present period is, in terms of the deed—

" On the effects of volcanic action in the production of epidemic diseases in the animal and in the vegetable creation, and in the production of hurricanes and abnormal atmospherical vicissitudes."

The Prize is of the value of One Hundred Pounds Sterling, and is open to Competitors of all nations.

Essays intended for Competition, which must be written in the English language, to be received by the Secretary not later than 31st December, 1925. Each Essay must bear a motto, and be accompanied by a sealed envelope bearing the same motto outside, and the Author's name inside.

The successful Candidate must publish his Essay at his own expense, and present a printed copy of it to the College within the space of three months after the adjudication of the Prize.

May Thunderstorms

A TYPICAL period of thundery weather commenced, in the early hours of May 16th, at Brighton with a sharp storm which afterwards passed just east of London. On this and the following day the thunderstorms were very local, though they occurred as far north as the Shetlands. On the 18th and 19th thunderstorms were numerous over a large area in the British Isles and the Continent. In southern England they occurred chiefly during the afternoon and night of the 18th, and in the eastern districts on the following day. Parts of the Midlands experienced storms on both days. Rainfall was very heavy in places, with local flooding. At Witley, Mr. C. W. Dixon estimates that 38 mm. (1·5 in.) fell in 10 minutes during the afternoon of the 17th. This fall was extremely local, but totals of 25 mm. (1 in.) or more were recorded at several stations in the neighbourhood on the 18th. At Calshot (near Southampton) 34 mm. (1·34 in) fell on the night of the 18th, of which 16 mm. fell in 12 minutes. Thunder and lightning were severe in many of the storms, including one which crossed London from south-east to north-west shortly before midnight on the 18th.

The thunderstorms were associated with a shallow depression, which moved north-westward from France across the British Isles, and the gradual displacement of a warm south-easterly current extending to great heights by a colder westerly current. Many of the storms developed far in advance of this "cold front," which was not at all sharply defined, and there was no definite line squall.

The upper air observations for this period are of great interest. During the 27 hours ending 10h. on May 16th the temperature at 4,000 feet over south-east England rose 12° F., while in the middle layers of the troposphere it hardly changed, so that marked instability was developed, and air saturated at 4,000 feet and rising adiabatically would have found itself 15° F. warmer than the surrounding air when it reached 17,500 feet. Pilot balloon observations in south-east England and the Continent showed that the warm air current at 4,000 feet reached England from the south over a surface easterly wind, and had previously come from about east-south-east, probably originating in south-east Europe or the Mediterranean. Its relative humidity was high. Between the 16th and the 18th the changes in the upper air temperature and humidity were very small, but by the latter date the amount of instability was slightly less than on the former, so that the increased prevalence of thunderstorms must be attributed entirely to the "trigger" action of converging currents at the surface. On the morning of the 19th the boundary of the two currents was near Duxford, and temperature had fallen about 3° F. at all heights, the lapse-rate being unaltered. Pilot balloons showed that the surface south-west to west current undermined the south-east current and extended upwards, but no more observations of upper air temperature were obtained till the 21st, when it had fallen at all heights, the largest fall being 13° F. at 4,000 to 6,000 feet. The lapse rate was then of a type unsuitable for thunder, which was limited on that day to a few places in the north.

C.K.M.D.

"Derby Day Weather"

THE depression which arrived off the Hebrides from the westward on May 27th (Derby day) was of quite abnormal depth for the time of the year. Pressure was very low over the Hebrides both on that day and on the 28th, the actual lowest reading being 977·3 mb. (28·86 in.) at Castlebay at 18h. on the 28th. During the last half century readings below 980 mb. (28·94 in.) have occurred in the British Isles only three times in the second half of May and never in June. The previous occasions were on May 28th, 1877, when the barometer at Stornoway fell to the

low level of 968·8 mb. (28·61 in.); and on May 20th, 1887, and May 18th, 1920, when readings of about 979 mb. (28·91 in.) were obtained. This year's reading was thus the lowest for this season for 48 years.

A large rain area crossed the British Isles on the night of May 26th and on the 27th with considerable rainfall in all western districts and also in the neighbourhood of the English Channel. The passage of this rain area was timed in an unfortunate manner for south-east England where there was no sunshine and nearly continuous rain on the 27th. In spite of the depth of the depression gales were neither widespread nor severe though high winds were general along the south coast.

C.K.M.D.

Sea Fog over Land

ON Easter Saturday, April 11th, 1925, there was a sea fog over the English Channel and there was more or less mist over all the low ground between the sea and the South Downs. By the road between Worthing and Littlehampton I noticed at several points that cloudy patches formed over the bare earth of the ploughed fields whilst the green fields were free from cloud, except for the general homogeneous mist. There was a wind of three or four miles an hour from the south. The cloudy patches dissolved quickly when they were carried from a ploughed field to a grassy one. My observations were made about mid-day. As it was fine on the other side of the Downs it may be presumed that there was clear sky above the mist. I should like to enquire whether the contrast between the appearance of sea fog over bare soil and over grass is well known to observers. Is it only noticed with a high sun? Is it necessary for the soil to be damp? Does it occur over light soils as well as heavy?

F.J.W.W.

Floods in Peru

A FURTHER account of the Peruvian floods has been received from the British Consulate at Callao by the courtesy of the Hydrographer of the Navy. The rainfall was very heavy along the northern and southern coasts of Peru, and most of the sugar crops in the north and cotton crops in the south have been destroyed through heavy floods inundating the fields and carrying off the growing crops with them. In the central regions the amount of rainfall measured on the coasts was small, but the rains of the Sierra above were very heavy, so that the river Rimac, on which the capital Lima stands, and which is the natural conduit to the sea for all mountain waters in this area, broke all bounds, washing away a large part of the railway and over-

throwing the principal electric generating stations at Chosica. Consequently, most factories have had to close down, and transportation of produce, &c., is difficult. The crushing mills in the north are also idle on account of the failure of the electric supply. The fact that under normal conditions no rain occurs at all along the coastal regions of the country makes the disaster more serious, for even in the larger cities the houses are constructed of nothing more durable than adobe or mud bricks, and in many of the smaller villages the huts are only of cane, or willow reeds, sufficient to keep out the rays of the sun.

It is interesting to note that the preceding visitation of this nature occurred in 1891, or thirty-four years ago. The Brückner cycle has been shown to influence the rainfall of Chile, and it is possible that the same cycle is to be found in Peru.

The Kite Record

AT Groesbeck,* in Texas, on December 11th, a kite reached the height of approximately 6,860 metres above ground, 7,000 metres above sea level. This exceeded all previous records for altitude above ground in the United States, although higher altitudes above sea level had previously been reached at other stations.

The Evolution of Climate

THE second edition of *The Evolution of Climate*, by C. E. P. Brooks (London: Ernest Benn, Limited, 1925, 8s. 6d. net.), contains an introduction in which the most important palæoclimatological work published during the years 1922 to 1924 is reviewed. Among this work we may notice the "solar-cyclonic" theory of climatic changes by Huntington and Visher; a discussion of the climatic history of the Antarctic from the earliest times, in the volume of the results of the British (Terra Nova) Antarctic Expedition, by C. S. Wright and R. E. Priestley; and an important work by H. Gams and R. Nordhagen on "Postglaziale Klima änderungen und Erdkrusten-bewegungen in Mitteleuropa." The last-mentioned publication sets out convincing evidence that the last phase of the Quaternary Ice Age, the Daun re-advance, occurred as late as 850 B.C., and thus came well within the historic period. Among the minor papers discussed is the most recent work of G. de Geer, on the absolute dating of the closing stages of the glaciation of America, in which it is shown from the thicknesses of the annual clay deposits by the thaw-water that the climatic fluctuations during certain stages of the retreat in North America ran so closely parallel with parts of the Swedish series as to be unquestionably of the same age.

*Washington, *M. W. Rev*, 1924, *p.* 599.

The Retirement of Dr. Chree

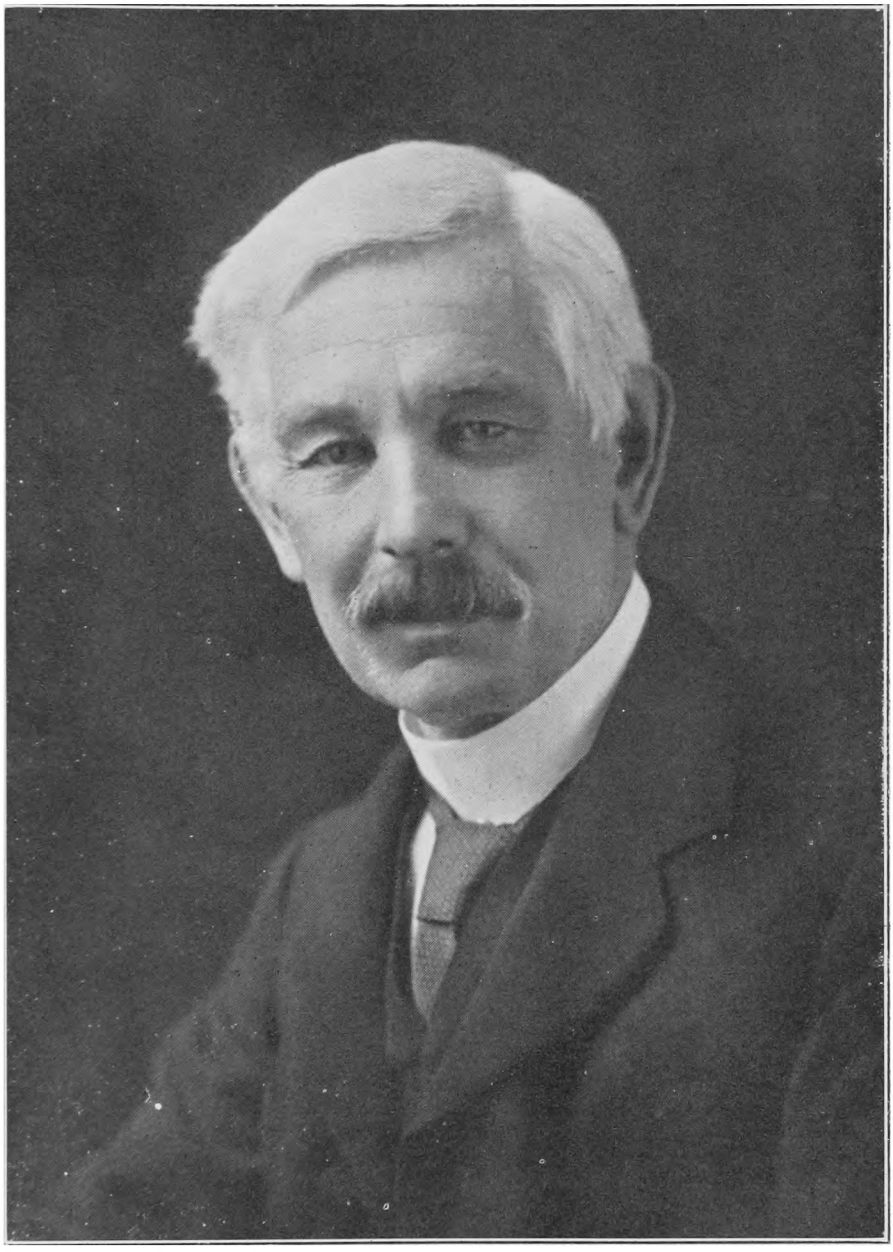
On the 5th May, 1925, Dr. Charles Chree, F.R.S., retired from the superintendentship of the Kew Observatory on reaching the age limit of 65. Dr. Chree was appointed Superintendent of Kew Observatory in 1893 and from that date Dr. Chree's history has been that of the Kew Observatory. The Observatory was then under the Kew Committee of the Royal Society and was responsible for a large amount of testing work in addition to magnetic and meteorological observations. Watches, chronometers, compasses, magnetic instruments, thermometers, barometers and optical instruments were tested and received "Kew Certificates." It is from the well-deserved reputation of the accuracy of these certificates, each bearing the Superintendent's signature, that Kew is so well-known to the British public.

In 1900 the National Physical Laboratory was founded and its first home was at the Kew Observatory. When, in 1910, new buildings were ready at Teddington and the National Physical Laboratory with the testing work was transferred there, the Observatory, with Dr. Chree still in charge as Superintendent, passed to the Meteorological Office. From this date Kew Observatory has remained in the true sense of the word an observatory, and regular observations and research in terrestrial magnetism, atmospheric electricity, meteorology and seismology have been its chief work. At the end of last year, owing to the ever increasing interference of London's electrical railways, the magnetic work had to be discontinued.

Dr. Chree's great powers as a physicist have been the predominating influence in maintaining the reputation of Kew Observatory during the last 32 years. His brilliant career at the universities of Aberdeen and Cambridge had prepared him for his work, and he has never ceased to produce valuable original work; his papers on terrestrial magnetism and atmospheric electricity have brought him world-wide fame. Although of a very retiring disposition Dr. Chree has never shirked the responsibilities which go with a dominating position in the scientific world, and he has filled the posts of President of the Physical Society and President of the Royal Meteorological Society and at present has the unique distinction of being President of both the international organisations which deal with the subjects of terrestrial magnetism and atmospheric electricity

By the retirement of Dr. Chree the Meteorological Office loses one of the most distinguished and trusted members of its staff. Fortunately the loss is confined to the Meteorological Office and does not extend to Science, either in its national or international aspects. Dr. Chree is still a very young man in everything but years and experience. Science can therefore hope for much more service from him in the future, and it is not giving away

to face p. 120



Elliott & Fry, Photographers

DR. C. CHREE, F.R.S.

to face p. 121

GEORGE MARWOOD WATSON, 1897-1925.

any secret to say that Dr. Chree has already made arrangements to continue several investigations on which he has already worked, but the completion of which has been delayed by the administrative work of the post which he has now relinquished.

Dr. Chree has already received many honours, amongst them the James Watt Medal of the Institution of Civil Engineers and the Hughes Medal of the Royal Society. It is the wish of every one of his late colleagues that he may have health and strength to gather still more of these marks of his distinguished service to geophysical science.

G.C.S.

Obituary

Father Aloysius Laurence Cortie, S.J.—At Stonyhurst, on May 16th, the death occurred of Father A. L. Cortie, at the age of 66. Father Cortie was born on April 22nd, 1859, and was educated at Stonyhurst College. He entered the Society of Jesus at Roehampton in 1878. In 1881 he joined the staff at Stonyhurst, and in 1919 was appointed Director of the College Observatory, taking charge of both the meteorological and astronomical activities.

Father Cortie was a distinguished astronomer, his main interest being concerned with the relation between sunspots and terrestrial magnetism, upon which subject he contributed many papers to the Royal Astronomical Society, thus carrying on the work done by his predecessor, Father Sidgreaves. In 1922 he was appointed a member of the Committee on the Solar Atmosphere at the Astronomical Union, and attended the Congress at Rome. Afterwards, as representative of Stonyhurst Observatory, he was made doctor of all the faculties of Padua on the occasion of the seventh centenary of the foundation of that University. He became a Fellow of the Royal Meteorological Society in 1924. His contributions to scientific journals and to the reports of the British Association were numerous. He was also a musician of no mean order, and for 19 years directed the music of the College.

Mr. George Marwood Watson.—By the death of Mr. G. M. Watson the Advisory Committee on Atmospheric Pollution has lost an enthusiastic and able worker. Mr. Watson commenced work with the Committee in February, 1919, and, except for an interval from December, 1919, to September, 1920, when he was incapacitated by illness, continued with the Committee until November, 1924, when failing health compelled him to cease work and return to his home at Grimsby, where he died on April 9th, 1925, at the age of 28. Mr. Watson was one of those rare men whose work is their chief pleasure ; an able physical chemist, he had also a mechanical bent which was of great value in dealing

with the novel problems involved in the study of atmospheric pollution. These qualities, added to a character of transparent honesty, made him a man whom it will be difficult to replace. His early death has cut short a career of great usefulness, more especially as the researches in which he was engaged dealt with problems now recognised as of vital importance to the health and economic well-being of the community.

M. Camille Flammarion. M. Flammarion, the well-known French astronomer, died at the Juvisy Observatory on June 4th, at the age of 83 years. He is mainly known as a great popularizer of the science of astronomy, and many of his numerous works have been translated into English. In 1887 Flammarion founded the Astronomical Society of France. One of his hobbies was ballooning, and in 1872 he published a large work on meteorology entitled *L'Atmosphère* which was afterwards translated into English. The *Annuaire Astronomique et Météorologique*, edited by Flammarion, has now reached its sixty-first year.

News in Brief

We regret to learn of the death at Appenzell, at the age of 73 years, of M. Jakob Bommer, director of the Swiss Observatroy at Santis until 1919.

It was announced in the list of Honours awarded on the occasion of the King's Birthday that Vice-Admiral F. Learmonth, C.B., C.B.E., formerly Hydrographer of the Navy, and an ex-officio member of the Meteorological Committee, had been made a Knight Commander of the Order of the British Empire; and Mr. J. P. G. Rose (a member of the Meteorological Committee) a Companion of the Order of the Bath.

Lieut.-Col. J. U. Hope, D.S.O., R.A., has been appointed to the Meteorological Committee in place of Lieut.-Col. D. Clapham.

The Weather of May, 1925

THE weather of May was for the most part changeable and showery with many bright periods. Thunderstorms were of frequent occurrence and the rainfall was above normal. On the first of the month large amounts of sunshine were recorded—over 13 hours at Aberystwyth and Falmouth—but after this the weather became rather cool and cloudy with considerable rain at times as a depression moved slowly over the British Isles. As much as 30 mm. (1·2 in.) of rain were measured at Tiverton, Devon, on the 6th. Ground frosts were experienced in many places, the grass minimum temperature at Birr Castle (King's County) falling to 24° F. on the 5th. On the 10th a ridge of

high pressure began to spread north-eastwards from the Azores anticyclone with a consequent improvement in the general weather. Temperature rose to between 70° and 80° F. in many parts of England (*e.g.* 80° F. was recorded at London, Norwich and Margate on the 16th). In the extreme north of Scotland and in parts of Ireland, however, the skies continued cloudy and the temperature did not rise above 60° F. On the south-west coasts of England early morning fog was prevalent between the 13th and 16th. After the 16th another depression approached from the Atlantic and there was a renewal of thundery conditions. Thunderstorms were numerous over a large area in the British Isles and the Continent on the 18th and 19th and were associated with heavy rain; 45 mm. (1·76 in.) were recorded at Derby and 37 mm. (1·46 in.) at Calshot (Hants) on the 19th.* During the last ten days of the month pressure remained generally low† over the British Isles and changeable weather with local heavy rain prevailed. 74 mm. (2·93 in.) were recorded at L. Llydaw (Snowdon) on the 26th, and 36 mm. (1·43 in.) at Totennyworth Park (Sussex) on the 27th. Sunshine amounts of about 14 hours were also recorded during this period at many places but the temperature gradually fell, maximum readings round about 65° occurring during the last two or three days. In the extreme north the temperature did not reach 60° F. throughout the month, the highest reading at Wick being 57° F. During the last two or three days strong to high south-westerly winds were experienced in many parts of the kingdom, and gales were recorded in north-west Ireland throughout the 30th.

The total rainfall for the month was more than twice the normal at many places in the Midlands and the southern districts of England and in the central districts of Scotland and Ireland. In Argyll, it was more than three times the normal, *e.g.*, at Eallabus, Islay, it was 361 per cent. of the normal, and at Inveraray Castle 308 per cent.

Pressure was below normal over Europe and the North Atlantic with the exception of the greater part of Scandinavia where pressure was slightly above normal as also in Spitsbergen and in a belt from Bermuda to Spain. The deficit exceeded 5 mb. over the British Isles, part of Holland and most of Iceland and reached 10 mb. in north-east Ireland. Thie distribution favoured a southerly or south-westerly type of weather. Temperature was above normal in the British Isles and northern Europe, and rainfall was slightly in excess. In Sweden, the temperature was about 3° F. above normal and the rainfall distribution irregular, the greatest excess (20 to 30 mm.) being found in the western part of middle Sweden. Thunderstorms accompanied by heavy rain occurred in Holland early in the month; between the 1st

* See p. 116. † See page 117.

[*Continued on p.* 128.

Rainfall: May, 1925: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square.....	1·66	42	93	*War.*	Birmingham, Edgbaston	2·97	75	139
Sur .	Reigate, Hartswood...	2·18	55	128	*Leics*	Thornton Reservoir ..	5·07	129	252
Kent.	Tenterden, View Tower	2·71	69	173	,, .	Belvoir Castle.....	3·52	89	167
,, .	Folkestone, Boro. San.	1·96	50	...	*Rut .*	Ridlington.....	3·52	89	...
,, .	Broadstairs, St. Peter's	2·08	53	125	*Linc.*	Boston, Skirbeck	3·28	83	186
,, .	Sevenoaks, Speldhurst.	2·75	70	...	,, .	Lincoln, Sessions House	3·67	93	197
Sus .	Patching Farm.....	4·02	102	217	,, .	Skegness, Estate Office.	2·78	71	164
,, .	Brighton, Old Steyne .	...	..	...	,, .	Louth, Westgate	3·10	79	153
,, .	Tottingworth Park....	4·05	103	225	,, .	Brigg	3·78	96	202
Hants	Ventnor, Roy. Nat. Hos.	3·44	87	202	*Notts.*	Worksop, Hodsock....	3·49	89	175
,, .	Fordingbridge, Oaklnds	4·54	115	218	*Derby*	Mickleover, Clyde Ho..	5·56	141	282
,, .	Ovington Rectory	4·07	103	188	,, .	Buxton, Devon. Hos...	5·50	140	177
,, .	Sherborne St. John Rec.	3·67	93	189	*Ches.*	Runcorn, Weston Pt...	3·16	80	137
Berks	Wellington College...	2·98	76	160	,, ..	Nantwich, Dorfold Hall	4·61	117	...
,, .	Newbury, Greenham..	4·17	106	222	*Lancs*	Manchester, Whit. Pk.	5·12	130	241
Herts.	Bennington House....	2·32	59	123	,, ..	Stonyhurst College....	3·98	101	140
Bucks	High Wycombe	3·08	78	175	,, ..	Southport, Hesketh...	3·98	101	190
Oxf..	Oxford, Mag. College..	2·57	65	144	,, ..	Lancaster, Strathspey.	4·53	115	...
Nor .	Pitsford, Sedgebrook..	2·79	71	146	*Yorks*	Sedbergh, Akay	6·12	155	191
,, .	Eye, Northolm.....	3·62	92	...	,, .	Wath-upon-Dearne ...	3·14	80	155
Beds.	Woburn, Crawley Mill.	2·26	57	118	,, .	Bradford, Lister Pk...	4·48	114	214
Cam.	Cambridge, Bot. Gdns.	1·70	43	97	,, .	Wetherby, Ribston H..	4·50	114	217
Essex	Chelmsford, County Lab	2·16	55	150	,, .	Hull, Pearson Park ...	2·48	63	128
,, .	Lexden, Hill House...	2·44	62	...	,, .	Holme-on-Spalding ...	3·32	84	...
Suff .	Hawkedon Rectory ...	2·11	54	114	,, .	West Witton, Ivy Ho..	4·04	103	...
,, .	Haughley House.....	2·16	55	...	,, .	Felixkirk, Mt. St. John	3·39	86	180
Norf.	Beccles, Geldeston....	2·44	62	138	,, .	Pickering, Hungate ...	2·00	51	...
,, .	Norwich, Eaton	2·05	52	106	,, .	Scarborough.....	1·55	39	81
,, .	Blakeney	1·91	49	121	,, .	Middlesbrough	2·47	63	129
,, .	Swaffham	2·72	69	155	,, .	Baldersdale, Hury Res.	4·13	105	155
Wilts.	Devizes, Highclere....	3·60	91	199	*Durh.*	Ushaw College	2·61	66	121
,, .	Bishops Cannings	3·41	87	175	*Nor .*	Newcastle, Town Moor.	2·25	57	111
Dor .	Evershot, Melbury Ho.	4·06	103	199	,, .	Bellingham, Highgreen	4·58	116	...
,, .	Weymouth, Westham..	3·15	80	194	,, .	Lilburn Tower Gdns...	3·10	79	...
,, .	Shaftesbury, Abbey Ho.	4·87	124	231	*Cumb*	Geltsdale.....	4·02	102	...
Devon	Plymouth, The Hoe...	3·98	101	193	,, .	Carlisle, Scaleby Hall .	4·00	101	167
,, .	Polapit Tamar	4·59	117	227	,, .	Seathwaite M.....	14·60	371	198
,, .	Ashburton, Druid Ho..	5·52	140	206	*Glam.*	Cardiff, Ely P. Stn.....	4·77	121	191
,, .	Cullompton	4·86	123	225	,, .	Treherbert, Tynywaun	9·84	250	...
,, .	Sidmouth, Sidmount ..	4·65	118	237	*Carm*	Carmarthen Friary....	7·55	192	273
,, .	Filleigh, Castle Hill ...	5·92	150	...	,, .	Llanwrda, Dolaucothy.	7·29	185	216
,, .	Barnstaple, N. Dev. Ath.	4·39	111	212	*Pemb*	Haverfordwest, School	4·53	115	181
Corn.	Redruth, Trewirgie ...	4·62	117	200	*Card.*	Gogerddan.....	...	..	...
,, .	Penzance, Morrab Gdn.	3·11	79	141	,, .	Cardigan, County Sch. .	3·88	99	...
,, .	St. Austell, Trevarna..	5·57	141	230	*Brec .*	Crickhowell, Talymaes	5·20	132	...
Soms	Chewton Mendip	4·74	120	172	*Rad .*	Birm. W. W. Tyrmynydd	5·96	151	174
,, .	Street, Hind Hayes ...	3·20	81	...	*Mont.*	Lake Vyrnwy	5·94	151	189
Glos..	Clifton College	4·65	118	221	*Denb.*	Llangynhafal	3·14	80	...
,, .	Cirencester	3·85	98	229	*Mer .*	Dolgelly, Bryntirion..	4·97	126	150
Here .	Ross, Birchlea	3·34	85	157	*Carn.*	Llandudno	3·15	80	166
,, .	Ledbury, Underdown.	3·04	77	149	,, .	Snowdon, L. Llydaw 9	12·97	329	...
Salop	Church Stretton.....	3·21	81	124	*Ang .*	Holyhead, Salt Island.	3·71	94	189
,, .	Shifnal, Hatton Grange	2·77	70	134	,, .	Lligwy	3·90	99	...
Staff.	Tean, The Heath Ho...	5·59	142	260	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	2·88	73	140		Douglas, Boro' Cem...	4·69	119	185
,, .	Blockley, Upton Wold.	3·43	87	160	*Guernsey*				
War.	Farnborough.....	2·54	65	113		St. Peter P't, Grange Rd	4·79	122	282

Erratum: Geltsdale for April, 4·00 in. 102 mm.

Rainfall: May, 1925: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	3·70	94	147	*Suth.*	Loch More, Achfary...	5·15	131	113
,, .	Pt. William, Monreith .	4·30	109	...	*Caith*	Wick	2·11	53	102
Kirk.	Carsphairn, Shiel.	8·73	222	...	*Ork .*	Pomona, Deerness	2·68	68	135
,, .	Dumfries, Cargen.....	6·21	158	206	*Shet .*	Lerwick	2·22	56	106
Dum	Drumlanrig	6·55	166	250					
Roxb	Branxholme	5·79	147	257	*Cork.*	Caheragh Rectory	6·86	174	...
Selk .	Ettrick Manse.....	10·06	256	...	,, ..	Dunmanway Rectory.	6·71	170	197
Berk.	Marchmont House	4·05	103	164	,, ..	Ballinacurra	4·92	125	207
Hadd	North Berwick Res....	3·44	87	173	,, ..	Glanmire, Lota Lo. ...	4·24	108	173
Midl	Edinburgh, Roy. Obs..	4·29	109	245	*Kerry*	Valencia Obsy.	4·38	111	138
Lan .	Biggar	4·68	119	233	,, .	Gearahameen	10·40	264	...
Ayr .	Kilmarnock, Agric. C..	6·26	159	271	,, .	Killarney Asylum.....	4·69	119	153
,, .	Girvan, Pinmore.....	5·71	145	192	,, .	Darrynane Abbey	5·90	150	198
Renf.	Glasgow, Queen's Pk..	6·24	159	256	*Wat .*	Waterford, Brook Lo..	4·97	126	214
,, .	Greenock, Prospect H..	9·22	234	267	*Tip .*	Nenagh, Cas. Lough...	4·99	127	202
Bute.	Rothesay, Ardencraig.	7·78	198	257	,, .	Tipperary	4·28	109	...
,, .	Dougarie Lodge	6·30	160	...	,, .	Cashel, Ballinamona ..	3·69	94	154
Arg .	Ardgour House	11·43	290	...	*Lim .*	Foynes, Coolnanes	4·90	125	210
,, .	Manse of Glenorchy..	8·74	222	...	,, .	Castleconnell Rec.	4·68	119	...
,, .	Oban	7·05	179	...	*Clare*	Inagh, Mount Callan ..	7·50	191	...
,, .	Poltalloch	6·79	173	235	,, .	Broadford, Hurdlest'n.	5·40	137	...
,, .	Inveraray Castle.....	12·09	307	308	*Wexf*	Newtownbarry	5·04	128	...
,, .	Islay, Eallabus.....	9·57	243	361	,, .	Gorey, Courtown Ho...	4·89	124	220
,, .	Mull, Benmore	10·80	274	...	*Kilk.*	Kilkenny Castle	4·45	113	201
Kinr.	Loch Leven Sluice	5·66	144	232	*Wic .*	Rathnew, Clonmannon	4·36	111	...
Perth	Loch Dhu	11·65	296	259	*Carl.*	Hacketstown Rectory .	6·08	154	234
,, ..	Balquhidder, Stronvar.	10·32	262	255	*QCo..*	Blandsfort House.....	5·30	135	218
,, ..	Crieff, Strathearn Hyd.	6·19	157	249	,,	Mountmellick	5·52	140	...
,, ..	Blair Castle Gardens ..	4·62	117	228	*KCo.*	Birr Castle.....	4·75	121	213
,, .	Coupar Angus School..	3·51	89	144	*Dubl.*	Dublin, FitzWm. Sq...	5·15	131	268
Forf.	Dundee, E. Necropolis.	3·77	96	180	,, .	Balbriggan, Ardgillan .	4·06	103	195
,, .	Pearsie House.....	5·60	142	...	*Me'th*	Drogheda, Mornington	4·27	109	...
,, .	Montrose, Sunnyside..	2·94	75	144	,, .	Kells, Headfort.....	5·58	142	207
Aber.	Braemar Bank	4·30	109	180	*W.M*	Mullingar, Belvedere .	5·93	151	242
,, .	Logie Coldstone Sch. ..	3·43	87	138	*Long*	Castle Forbes Gdns....	6·69	170	259
,, .	Aberdeen, Cranford Ho	...	..	...	*Gal .*	Ballynahinch Castle ..	5·07	129	141
,, .	Fyvie Castle	2·90	74	...	*Mayo*	Mallaranny.....	5·05	129	...
Mor .	Gordon Castle.....	2·70	69	127	,, .	Westport House.....	5·23	133	183
,,	Grantown-on-Spey....	1·99	51	85	,, .	Delphi Lodge	7·10	180	...
Na .	Nairn, Delnies.....	1·85	47	103	*Sligo*	Markree Obsy.	5·82	148	212
Inv..	Ben Alder Lodge	5·24	133	...	*Cav'n*	Belturbet, Cloverhill..	5·03	128	202
,, .	Kingussie, The Birches	2·90	74	...	*Ferm*	Enniskillen, Portora ..	5·57	141	...
,, .	Loch Quoich, Loan....	11·30	287	...	*Arm.*	Armagh Obsy.	4·59	117	193
,, .	Glenquoich	10·53	267	192	*Down*	Warrenpoint	5·40	137	...
,, .	Inverness, Culduthel R.	3·55	90	...	,, .	Seaforde	5·12	130	195
,, .	Arisaig, Faire-na-Squir	7·54	191	...	,, .	Donaghadee, C. Stn...	4·03	102	178
,, .	Fort William.....	9·42	239	140	,, .	Banbridge, Milltown .	4·09	104	182
,, .	Skye, Dunvegan.....	6·55	166	...	*Antr.*	Belfast, Cavehill Rd. .	6·68	170	...
,, .	Barra, Castlebay	2·75	70	...	,, .	Glenarm Castle.....	5·35	136	...
R&C	Alness, Ardross Cas. ..	3·80	97	146	,, .	Ballymena, Harryville	5·30	135	185
,, .	Ullapool.....	2·68	68	...	*Lon .*	Londonderry, Creggan	3·68	93	140
,, .	Torridon, Bendamph..	6·02	153	132	*Tyr .*	Donaghmore	5·76	146	...
,, .	Achnashellach	6·64	169	...	,, .	Omagh, Edenfel	4·88	124	188
,, .	Stornoway	3·67	93	143	*Don .*	Malin Head	2·73	69	138
Suth.	Lairg	2·90	74	...	,, .	Rathmullen.....	3·82	97	...
,, .	Tongue Manse.....	3·97	101	167	,, .	Dunfanaghy	3·76	96	145
,, .	Melvich School.....	2·38	61	116	,, .	Killybegs, Rockmount.	5·84	148	162

Erratum: Valencia for April, 5·72 in. 145 mm. 156 per cent.

Climatological Table for the British Empire, December, 1924

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.							
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1015·3	+ 1·6	55	31	47·9	39·8	43·9	+ 3·6	42·8	88	6·9	72	+ 14	18	1·5	19
Gibraltar	1023·2	+ 3·1	67	43	61·9	51·5	56·7	+ 0·7	53·4	80	5·5	63	— 79	12	...	...
Malta	1019·1	+ 3·2	67	49	61·9	54·5	58·2	+ 1·2	53·9	80	5·3	176	+ 90	18	4·9	51
Sierra Leone	1012·4	+ 1·2	90	67	87·7	71·5	79·6	— 1·9	73·9	69	3·4	0	— 37	0	...	...
Lagos, Nigeria	1009·1	— 1·4	91	73	88·2	75·6	81·9	+ 0·6	77·8	79	5·1	49	+ 28	4	...	...
Kaduna, Nigeria	1015·3	+ 2·5	100	...	89·3	...	...	...	58·9	43	1·3	0	— 3	0	...	...
Zomba, Nyasaland	1008·9	+ 0·3	97	63	87·4	67·2	77·3	+ 4·6	...	85	7·9	165	—126	16	...	...
Salisbury, Rhodesia	1008·6	— 0·8	85	56	77·4	60·2	68·8	— 1·1	63·5	73	7·1	295	+149	21	...	...
Cape Town	1013·6	— 0·7	94	55	80·8	62·2	71·5	+ 3·9	65·2	58	2·3	1	— 21	1	...	...
Johannesburg	1012·1	+ 0·5	80	47	72·3	54·0	63·1	— 2·0	57·0	76	7·3	146	+ 23	17	6·2	45
Mauritius	1014·1	+ 0·1	90	64	85·6	69·6	77·6	— 0·7	71·2	74	6·5	181	+ 61	11	7·3	55
Bloemfontein	...	...	88	50	79·2	57·2	68·2	— 3·6	61·3	66	4·7	116	+ 54	11	...	...
Calcutta, Alipore Obsy.	1016·3	+ 0·6	80	52	76·5	57·7	67·1	+ 0·6	58·4	87	3·4	0	— 5	0*	...	...
Bombay	1013·5	+ 0·2	88	65	84·9	70·5	77·7	+ 0·4	67·5	76	1·1	0	— 2	0*	...	...
Madras	1014·4	+ 0·9	85	63	83·1	68·1	75·6	— 0·9	70·6	81	3·1	22	—136	4*	...	...
Colombo, Ceylon	1011·0	+ 1·2	90	69	87·0	72·2	79·6	— 0·1	75·0	66	3·8	275	+135	11	9·0	77
Hong Kong	1019·2	— 0·5	73	52	67·4	57·4	62·4	— 0·6	54·9	61	4·0	18	— 13	4	7·7	72
Sandakan	...	...	89	72	86·6	74·3	80·5	+ 0·4	76·1	79	...	213	—236	7	...	...
Sydney	1013·0	+ 1·1	93	48	72·5	58·1	65·3	— 4·7	59·4	69	5·0	68	+ 1	12	7·2	50
Melbourne	1014·3	+ 1·8	104	43	72·9	52·8	62·9	— 1·4	56·7	59	4·9	75	+ 16	12	8·4	56
Adelaide	1014·9	+ 1·7	107	45	81·6	57·1	69·3	— 1·9	56·7	41	2·9	8	— 16	4	10·2	71
Perth, W. Australia	1014·3	+ 1·0	97	49	83·2	60·3	71·7	+ 1·1	61·6	53	2·1	0	— 15	0	11·1	78
Coolgardie	1013·1	+ 1·9	109	46	89·8	59·2	74·5	— 1·3	59·4	28	3·1	2	— 16	2	...	...
Brisbane	1012·4	+ 0·5	91	58	81·9	64·8	73·3	— 3·1	66·8	61	5·2	40	— 85	8	7·7	55
Hobart, Tasmania	1012·3	+ 2·6	81	40	65·6	48·9	57·3	— 3·1	51·1	63	6·1	24	— 26	11	8·0	53
Wellington, N.Z.	1007·6	— 4·5	75	46	65·6	53·7	59·7	— 0·8	55·1	74	7·4	289	+207	16	5·9	39
Suva, Fiji	1007·8	— 0·8	93	67	87·9	71·6	79·7	+ 0·8	73·5	78	5·2	257	— 51	22	...	...
Apia, Samoa	1008·4	0·0	89	71	84·1	74·3	79·2	— 0·1	76·7	77	5·7	393	+ 47	18	5·8	45
Kingston, Jamaica	1015·4	+ 1·4	89	65	86·8	68·4	77·6	— 0·1	71·1	68	4·5	14	— 27	3	...	...
Grenada, W.I.	1013·9	+ 2·0	84	70	81·9	72·6	77·3	— 0·8	72·5	77	5·3	192	+ 4	27	...	...
Toronto	1019·9	+ 2·5	53	— 2	30·2	17·7	23·9	— 2·3	21·1	40	7·3	59	— 13	18	2·0	22
Winnipeg	1023·2	+ 5·3	36	—29	3·8	—10·0	—3·1	— 8·8	...	...	5·4	18	— 6	8	2·4	29
St. John, N.B.	1015·0	+ 0·8	50	— 9	26·2	12·9	19·5	— 4·9	18·2	56	5·7	90	— 16	13	3·7	42
Victoria, B.C.	1021·2	+ 4·4	58	12	41·7	33·6	37·7	— 3·8	35·5	86	6·5	160	+ 10	18	2·8	33

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

Climatological Table for the British Empire for the Year 1924

STATIONS	PRESSURE		TEMPERATURE						Mean Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values							Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
			Max.	Min.	Max	Min.	½ max. and min.	Diff. from Normal								
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1014·0	— 1·4	86	24	56·7	44·2	50·4	+ 0·7	48·0	79	6·9	786	+180	177	3·8	29
Gibraltar	1016·9	— 1·0	91	38	70·4	58·0	64·2	— 0·1	58·8	74	4·9	1117	+208	104	...	...
Malta	1015·5	+ 0·7	102	40	71·6	61·7	66·7	+ 1·5	60·9	75	3·8	577	+116	90	8·0	65
Sierra Leone	1012·3	+ 0·5	94	62	86·7	72·3	79·5	— 1·4	75·1	76	5·3	3802	—115	178	...	...
Lagos, Nigeria	1009·8	— 1·6	99	65	87·6	75·8	81·7	+ 1·5	77·5	76	5·6	1268	—552	101	...	...
Kaduna, Nigeria	1014·0	+ 1·6	100	...	89·1	...	...	...	69·5	67	1·0	1384	+ 38	122	...	...
Zomba, Nyasaland	1012·7	+ 0·6	97	46	80·3	60·2	70·3	+ 1·2	...	85	5·5	873	—538	107	...	...
Salisbury, Rhodesia	1012·7	— 0·6	92	33	77·9	53·1	65·5	+ 0·2	57·1	57	3·2	652	—156	72	...	...
Cape Town	1017·4	+ 0·4	100	36	71·2	53·9	62·5	+ 0·4	57·9	69	4·0	478	—170	94	...	...
Johannesburg	1017·3	+ 0·4	89	26	68·9	49·0	58·9	— 0·6	49·3	63	3·7	736	— 64	106	8·1	69
Mauritius	1015·8	— 0·3	91	54	79·8	67·2	73·5	— 0·5	68·3	76	6·0	1411	+150	167	7·2	60
Bloemfontein	...	...	101	18	73·3	46·1	59·7	— 1·7	50·2	63	2·7	618	+ 23	73	...	...
Calcutta, Alipore Obsy.	1007·3	— 0·2	111	52	89·0	72·6	80·8	+ 2·1	72·5	82	5·1	1297	—271	66*	...	...
Bombay	1008·4	— 0·7	95	61	87·1	75·7	81·4	+ 0·9	73·0	74	4·4	1326	—500	67*	...	...
Madras	1008·5	— 0·3	107	63	91·3	75·1	83·2	+ 0·3	75·2	73	4·8	1158	— 97	64*	...	...
Colombo, Ceylon	1009·5	+ 0·1	93	67	86·9	75·0	81·0	— 0·2	77·3	72	7·0	3109	+953	198	6·8	57
Hong Kong	1012·1	— 0·5	93	47	76·8	68·8	72·8	+ 0·5	67·6	77	7·0	2505	+392	141	5·5	46
Sandakan	...	...	93	70	87·5	75·2	81·4	+ 0·1	76·8	79	...	3215	+167	149	...	...
Sydney	1015·7	— 0·2	98	40	71·3	55·5	63·4	+ 0·4	57·1	66	4·8	939	—285	136	6·6	55
Melbourne	1015·9	— 0·4	104	33	65·5	49·4	57·4	— 1·0	53·1	68	6·3	926	+279	177	5·2	42
Adelaide	1017·1	0·0	107	35	71·0	51·8	61·4	— 1·6	53·7	58	5·1	596	+ 64	143	6·5	53
Perth, W. Australia	1016·7	+ 0·3	106	38	73·5	54·7	64·1	+ 0·1	56·6	62	4·4	858	+ 4	119	7·4	61
Coolgardie	1016·3	+ 0·3	109	33	77·3	51·3	64·3	— 0·2	54·9	40	3·5	196	— 62	45	...	...
Brisbane	1015·9	+ 0·2	100	41	78·0	60·5	69·2	+ 0·3	64·0	66	4·7	1044	—113	112	7·3	61
Hobart, Tasmania	1011·9	— 0·7	89	32	60·3	46·5	53·4	— 0·9	48·9	70	6·4	730	+128	196	5·6	46
Wellington, N.Z.	1015·9	+ 1·8	84	31	62·9	51·3	57·1	+ 1·7	?52·6	74	6·5	1249	+ 17	164	5·3	43
Suva, Fiji	1011·8	+ 0·4	93	62	82·4	71·3	76·9	— 0·1	73·3	81	6·3	4288	+1434	250	...	...
Apia, Samoa	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kingston, Jamaica	1013·4	— 0·3	93	61	88·1	71·0	79·6	+ 0·3	73·0	69	5·5	995	+134	82	...	...
Grenada, W.I.	1013·6	+ 1·2	89	68	84·1	73·8	79·0	+ 0·3	74·4	76	4·8	2043	+116	227	...	...
Toronto	1016·2	— 0·2	90	— 6	53·0	36·3	44·7	+ 0·3	39·7	67	5·4	857	+ 7	156	5·8	46
Winnipeg	1016·7	+ 0·5	91	—31	44·9	25·5	35·2	+ 0·9	...	...	4·9	470	— 47	108	5·6	44
St. John, N.B.	1013·3	— 1·4	83	—19	48·4	33·4	40·9	— 0·3	37·6	75	6·0	991	—229	140	5·3	43
Victoria, B.C.	1018·0	+ 1·6	92	12	55·7	43·8	49·7	— 0·3	45·6	81	5·6	702	—125	136	6·2	47

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

[*Continued from p.* 123.

and the 6th 69 mm. of rain were measured at The Helder, where the average total for May is 43 mm. Heavy rain also occurred in Flanders causing floods locally. Severe storms were reported from Hungary on the 3rd and 11th; and on the 18th vineyards along the northern shores of the Lake of Bienna (Switzerland) were destroyed during a thunderstorm which also caused several landslides. On the 23rd, a small Turkish coasting steamer foundered in a storm at the entrance to the Bosphorus, forty-four of the passengers and crew being drowned, and a storm which swept over Anatolia on the 25th destroyed many buildings in Angora, Adana and Mersina. In eastern Persia the crop outlook is said to be bad, drought has affected the barley, while the opium crop has been damaged by cold. During the second half of the month the drought in Spain was broken and rain fell plentifully, in time to save the spring crops.

Rainfall was above normal in Australia with the exception of Western Australia and the northern part of Queensland where it was a little below. In the coastal regions of New South Wales, it was very heavy, varying from about twice the normal on the north coast to eight times the normal on the Upper Murrumbidgee, where floods occurred, the damage done being estimated at about £500,000. The drought in the west of the province was broken by beneficial rains during the latter part of the month.

High temperatures were recorded generally in the United States about the middle of the month, but northerly winds caused a sudden fall of temperature on the shores of Lake Superior on the 23rd and along the whole of the southern shores of the Great Lakes on the 24th, *e.g.*, the maximum reading at Duluth was 68° F. on the 22nd and 32° F. on the 23rd, and at Toledo (Ohio) 88° F. on the 23rd and 42° F. on the 24th. May 24th this year is stated to have been the coldest Empire Day in Ontario for 75 years.

The special message from Brazil states that the rainfall distribution was irregular in the northern and central regions, the total for the month in both districts being 18 mm. below normal, while in the south the rainfall was plentiful with 22 mm. above the normal. The pressure distribution of the month was characterized by the passage of a few large slow-moving anticyclones. The condition of the crops was generally good. Pressure at Rio de Janeiro was 0·4 mb. above normal and temperature 1·3° F. above normal.

Rainfall May, 1925—General Distribution

England and Wales ..	178	per cent. of the average 1881-1915.
Scotland	191	
Ireland	194	
British Isles	185	

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The New Edition of Exner's Dynamische Meteorologie

By Sir GILBERT WALKER, C.S.I., F.R.S.

THE appearance of the second edition of Exner's *Dynamische Meteorologie* forms a big landmark in the development of the subject. In the first edition—completed in 1915—a most successful effort was made to put together all that was then known about the theory of air movements; and while the work of Exner himself rightly and inevitably occupied a large place, justice was done to the fundamentally important work of Margules, which was drawn "as a red line" through the book. The last ten years have seen important developments in our science: the striking successes of Bjerknes and the Norwegian school have in England, to some extent, attracted attention away from the equally important advances made by the Austrian and the Lindenberg schools, and it is most fortunate that we have now available a systematic account of what is known, from the dynamical standpoint, of the problems of general meteorology and the phenomena of the atmosphere as a whole.

In the first chapter—on the laws of gases—are discussed the relations between the pressure, temperature and density of air containing moisture in its various forms, with Bezold's "pseudo-adiabatic" changes. In Chapter II. we find the general equations of motion of the air on the rotating earth; the horizontal deviating force thereby produced is, of course, that known in England as the geostrophic force; but the vertical component, by which an eastward moving body is lighter than a westward,

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is as large at the equator as the horizontal component; and though its direct effect may be merely to alter pressure, the inequality of this will affect the horizontal velocity. The next chapter—statics of the atmosphere—is concerned with relations between pressure, temperature and height in the atmosphere. The more physical treatment begins in Chapter IV., on the vertical temperature distribution in equilibrium; Exner remarks that on summer afternoons in the lower layers labile equilibrium, with potential temperature diminishing with height, is not only occasional, but is the rule. The vertical motion set up is slow enough for the temperature differences between the ascending or descending masses of air and its environment to be partly smoothed away; in place of a violent upheaval there may result merely a stationary circulation provided that the masses of air involved are not too large, as the exchange of heat is proportional to the surface, and the heat content to the volume of the mass. Exner next examines the effect, upon the vertical temperature gradient of a thin layer of air, of an ascent or descent of the whole layer, whether the temperature gradient within it is stable or not for the ascent of small masses of air: he shows, for example, that the descent of a layer of air with a gradient of 5° a kilometre from $5\frac{1}{2}$ kilometres to sea level will produce a uniform temperature in it. This is followed by an excellent account of the effect of conduction and radiation in producing the troposphere and stratosphere, and in particular of the work of Humphreys, Emden and Hergesell on the subject.

Chapter V. (kinematics) begins with Bjerknes' work on stream lines, and discusses the effect on the temperature in ascending or descending air when it moves inside a stream-tube of varying section: clearly such variation occurs whenever air ascends or descends in a column terminating near the ground, and the effect is appreciable.

In Chapter VI.—on the general dynamics of air movements—we have Helmholtz' analysis of the effects of dimensions on similarity of air movements; and then a discussion of some simple cases of motion without and with friction, the former including an interesting stationary motion of wave-like character, and the latter several new pieces of analysis due to Sandström, Hesselberg and Sverdrup. There follows "turbulence" or "exchange" as developed simultaneously by Taylor and Schmidt, and subsequently by Richardson. Developments by Gold, Köppen and Hesselberg are introduced, with an important and elegant theorem by Bjerknes extending Helmholtz' theorem regarding circulation. Vertical motion is then discussed, and the exchange of heat between the earth and moving air.

The energy of air movements is handled in the seventh chapter, such movements being maintained either by loss of potential

energy or by absorption of heat in a warm region and losing it in a cooler one. Much of our knowledge is due to Margules, who found a source of the energy in a cyclone in the potential energy of a mass of warmer air originally not entirely above a mass of colder air, the colder air subsequently spreading out in a layer below the warmer: he also examined the effect of latent heat and a transfer of heat as a source of energy for steady motion. Exner has here made considerable advances, and Sandström has investigated the continuous production of energy in vortices: for example, he finds a large horse-power produced on the north-west coast of Norway in winter by a cold seaward current above which is a warmer current. Exner also works out an approximate solution for land and sea breezes.

Chapter VIII., under the title "Stationary streams in the atmosphere," begins with Margules' handling of horizontal falls of temperature with stationary motion, and Bjerknes's determination of the inclination of surfaces of discontinuity.

The general circulation is treated in Chapter IX., and for the qualitative explanation reference must be made to paragraph 61: the very important conclusion is reached that in higher latitudes the general circulation must resolve itself into a consecutive series of circulations such as are observed in cyclones and anticyclones. In paragraph 64 a first effort is made to work out the transport of heat between lower and higher latitudes in connection with the heat received from the sun and radiated into space. Exner points out that there can be no stationary motion when gradients have different directions at different heights above the same place; for when the flow along the gradients leads to changes of temperature changes of weather must follow: and, accordingly, in a chart of the northern hemisphere (p. 243) the regions where isobars and isotherms cut at right angles are characterised by the frequent development of cyclones. The section on long-lasting anomalies in the general circulation contains some ingenious and valuable generalisations from collections of correlation coefficients; in the polar region temperatures and pressure both fall with an increase of the general circulation, while in latitude 20° N. pressure rises, the coefficient with polar pressure being as high as −·74.

In the tenth chapter we have accounts of investigations into the dynamics of cyclonic movements by Fujiwhara, Emden, Helmholtz, Guldberg and Mohn, Oberbeck and others. The interest tends to be more mathematical than physical, for a cyclone does not appear to assume a figure of revolution symmetrical on all sides until its activity is decreasing.

Non-periodic changes at a single place in the atmosphere (Chapter XI.) depend on the relations between the pressure and temperature conditions in a vertical line through the place,

and the discussion of these is a model of clearness. The question is still regarded as open, whether the actual changes of pressure on the ground are due merely to temperature changes or not (p. 290). Exner then discusses the effects of " advection " on change of pressure and temperature, and applies the method to forecasting changes in the weather map. Finally, we have a statement of the important relationships derived by Dines and by Schedler between the pressure at the ground and at 9 kilometres, the height of the troposphere, the mean temperature of the lowest 9 kilometres, and the temperature at the tropopause; and an able summary of the explanations that have been put forward.

Perhaps the most characteristic chapter is the twelfth—non-periodic changes in synoptic representation. Originally treated as a continuum, the air has during the past 20 years been more and more regarded as divided into parts which may be called " air-bodies," such that within one air-body all separate particles of matter are interchangeable. In dry air the potential temperature in an air-body is uniform, and it is only by a gain or loss of heat (or by condensation) that a fragment of air can leave its air-body. The surfaces of discontinuity between air-bodies are of vital importance, but will only remain constant in position when certain conditions are satisfied. The onrush of a mass of cold air has been elucidated by Köppen, Margules, Ficker and Schmidt, as well as by Exner, and the cold waves of Russia and Siberia lend themselves to quantitative treatment. The origin of cyclones extending up to a few kilometeres in height is then discussed, and after pointing out how eddies due to the west wind will form to the east of S. Greenland and produce an area of low pressure there, Exner describes how cyclones will form to the east of a wave of cold air acting like a barrier. Bjerknes' theory of the production of a cyclone by the interaction of cold and warm streams is fully discussed. For areas of high and low pressure extending up to the stratosphere Exner assumes that the explanation lies in the temperature conditions high up; and holds that a high anticyclone is due to a southerly stream which is warm below and extends up to the stratosphere to which it brings cold. A theory regarding the changes of the daily weather charts concludes the chapter.

The last chapter deals with periodic changes. The time-changes in air movements will depend partly on the distribution of the air itself and partly on the distribution of land and sea. The first influences which would persist if the earth's surface were uniform can scarcely produce regular fluctuations apart from the oscillation of the atmosphere as a whole (see below); and the explanation of local oscillations must therefore be sought in geographical data. By a rough approximation Exner finds

a period of 25 days with its sub-periods, which agrees well with Defant's determination for the northern hemisphere. Waves due to gravity and relative velocity at the interface of the media are discussed, and finally we have Margules' great work of the daily periods of wind and pressure of the air as a whole treated as a thin shell, and on its free elastic oscillations, which though published in 1892 seem to have been overlooked for a long time in England; such analysis is of course of vital importance in connection with the half-daily period of pressure.

The author is equally conspicuous for his wide knowledge of the literature of the subject—to remember his own contributions must have been no easy task—and for the clearness and sound judgment with which he presents his materials. The book is essential to all serious students of meteorology.

OFFICIAL NOTICE

Beaufort Weather Letters b, bc, c and o

The letters b, bc, c and o have been used for many years in the Meteorological Office as equivalent to certain definite amounts of cloud, and they have also been used in this sense by observers in the weather columns of the returns which they have supplied to the Office.

The last edition of the *Observers' Handbook** states :—

b—Blue sky, cloudless.
bc—A combination of blue sky with detached clouds.
c—Sky mainly cloudy, but with openings between the clouds.
o—Completely overcast.

and adds " These letters are intended to refer only to the amount of cloud visible, and not to its density, form or other quality. They have come to be regarded as corresponding to the cloud amounts in the scale o—10 :— b = 0 to 3, bc = 4 to 6, c = 7 or 8, o = 9 or 10."

Various difficulties have been experienced with this definition. For example, the conventional numerical definitions of b (viz., 0 to 3 of cloud) and of o (9 or 10 of cloud), may be at variance with the verbal definitions; again it seems incongruous to describe as o a sky covered with thin cirrus haze, while a sky four-fifths covered with heavy nimbus is called c. The precision implied by a fixed table of equivalents is also a difficulty; for, on the one hand, if present weather is being reported the

* 1921 Edition, p. 51-2.

information conveyed by the letters b, c or o is repeated in the column headed "cloud amount," while on the other hand if past weather is being reported, few observers are in a position to keep the continuous watch on the sky which the numerical definition really demands.

It appears that some observers (and especially marine observers) still use the letters more or less in the original sense, as intended by Admiral Beaufort; that is, they use them to describe "the appearance of the sky" and not merely the total amount of cloud. It seemed worth while, therefore, to attempt to discover exactly what the original significance of the letters was. As a result of a study of the original documents and logs of Admiral Beaufort it has been decided to revert (as nearly as possible) to the original definitions of the letters, which are as follows:—

(Beaufort's third log 1833-41).

b—Denotes blue sky whether with clear or hazy atmosphere.
c—Cloudy, i.e. detached opening clouds.
o—Overcast, i.e. the whole sky covered with one impervious cloud.

In order to carry out this policy the following Order has been issued from the Meteorological Office:—

Beaufort Notation of Weather—

The following definitions of the Beaufort Weather Notation will in future be adopted in Office practice.:—

Appearance of Sky—

b—Blue sky, whether with clear or hazy atmosphere.
c—Cloudy, i.e. detached opening clouds.
o—Overcast, i.e. the whole sky covered with one impervious cloud.
g—Gloomy.
u—Ugly, threatening.

The letters, b, c, o, g and u, are used to describe the general appearance of the sky.

The use of the letters g and u is sufficiently clear from the definitions given above. The following remarks apply to the use of the letters b, c and o.

o is used whenever the sky is completely overcast with a uniform layer of thick or heavy cloud; c is used to denote that there is some cloud present but o is not appropriate; b denotes that there is some blue sky.

In order to meet difficulties which occur when there are only small quantities of cloud or blue sky present, it has been decided that c shall not be used unless the sky is more than a quarter covered, and b unless there is more than a quarter of the sky free from cloud.

If there is both blue sky and cloud (with the above limitations) b and c will both be recorded.

The definitions given above will be introduced into the *Observer's Handbook* and other official instructions to observers as each comes up for reprint. Such alterations of current procedure at Headquarters or at Observatories and Outstations as are involved in this order will be made as from 1st January, 1926.

The spirit of these rules can perhaps be best explained by stating that the letters are intended to indicate the general effect which the appearance of the sky produces upon the observer's mind. This effect is frequently so well-defined that it is unnecessary to look at the sky in order to apprehend it, although no meteorological observer should be content to treat the matter in that way. It is an effect which any layman knows and appreciates without perhaps being able fully to describe it. The rules are intended to ensure that there is a standard of uniformity in the matter in the official reports.

It will be observed that there will be no set table of equivalents between Beaufort letters and cloud amount. Such a table would be inappropriate because it would imply greater precision than is generally practicable, and would also suggest that the letters are not concerned with any other quality than the amount of cloud. Under these rules a sky completely covered with cloud is classed either as c or as o after reference to other attributes of the cloud, such as uniformity and density. The use of o will therefore be less frequent than hitherto, while c will be more frequent.

The letters g and u may be used either alone or in association with the letters c and o to describe more exactly the appearance of the sky, while it is possible that u may also be used with b, for example, during the approach of a thunder-cloud.

The following examples of the use of c and o may be of service :—

(1) Sky covered or practically covered with high cloud. Entry c not o, as the cloud is not impervious.

(2) Sky quite covered with one kind of heavy cloud, the covering being however composed of separate clouds. Entry c, not o, as there is more than one cloud.

(3) Sky covered with two kinds of heavy clouds. Entry c, not o, for the same reason as in (2).

(4) Sky covered with alto-stratus of the thick variety. If the sun can be seen the cloud is not impervious and therefore c would be used. Occasional alto-stratus is sufficiently thick for o to be appropriate. The observer must decide which letter to use.

(5) Sky covered with thick stratus cloud. Entry o.

OFFICIAL PUBLICATIONS

The following publications have recently been issued:—

GEOPHYSICAL MEMOIRS.

No. 25. *Surface and Geostrophic Wind Components at Deerness, Holyhead, Great Yarmouth and Scilly.* By S. N. Sen, Ph.D. (No. 254*e*.)

This paper discusses the seasonal and annual variation of wind speed at the four chief anemograph stations of this country, with special reference to the development of the land and sea breeze on the east coast during the summer months. Wind data of a technical nature are also given. The main results are illustrated by means of diagrams.

No. 26. *Classification of Synoptic Charts for the North Atlantic for* 1896-1910. By E. V. Newnham, B.Sc. (No. 254*f*.)

Synoptic forecasting is still mainly an empirical science, and, although its position in this respect has been modified somewhat of recent years, the forecaster has to be guided very largely by his experience of what has happened before under similar conditions. When he is confronted by some particular distribution of pressure he requires a ready means of reference to similar distributions which have occurred in the past. Some years ago Col. Gold* classified the daily weather maps of western Europe into types for this purpose. Wireless messages now enable the daily weather chart to be drawn over a large part of the North Atlantic as well as over Europe and the neighbouring islands, and the present memoir, which classifies weather charts into types according to the pressure distribution over the North Atlantic and Europe as whole, provides a similar classification, but extending over a wider area. The basis of the classification is the position of the anticyclonic centres, which, being more permanent than the depressions, give the more durable features of the distribution.

PROFESSIONAL NOTES—

No. 40. *The Ground Day Visibility at Cranwell, Lincolnshire, during the period* 1*st April,* 1920 *to* 31*st December,* 1923. By W. H. Pick, B.Sc. (No. 245*t*).

No. 41. *Upper Air Temperatures in Egypt.* By E. V. Newnham, B.Sc. (No. 273*a*).

Mr. Stanley Single reports that he observed the Green Flash at sunset on March 28th, 85 miles south-east by south of St. Helena—the only occurrence during a five weeks' voyage.

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* Aids to Forecasting: Types of Pressure Distribution. By E. Gold, F.R.S. *Geophysical Memoirs*, No. 16, London, 1920.

Royal Meteorological Society

THE monthly meeting of this Society was held on Wednesday, June 17th, at 49, Cromwell Road, South Kensington, Capt. C. J. P. Cave, M.A., President, in the Chair.

J. E. Clark, I. D. Margary and R. Marshall—Report on the Phenological Observations in the British Isles from December, 1923, to November, 1924.

Although in this, the 34th Report (New Series), 365 sets of records were discussed as compared with about 120 before 1922, yet, in north-west Ireland and most of west and north Scotland, there are still very few records, and observers are badly needed. Records of great value kept by the Marshams of Stretton Strawless, almost without a break since 1736, have been discovered this year, and responses have been received from many parts of the world to the appeal for the need of universal, more or less, co-operative systematic observations. The records of plants, insects and birds were erratic during the spring, but most things were much later than in 1923. On the 30 years' average, flowers in the east and south-east were one or two weeks late and in north England and Scotland still later, yet the hazel was early. Insects appeared late, the delay ranging from 18 days late for the honey bee, to three, only, for the Orange Tip; the migrants were also late. Lateness and wet did not, however, cause poor blooming, that and vegetable growth being exceptional and little troubled by insect pests.

D. N. Harrison, B.A., and G. M. B. Dobson, D.Sc.—Measurements of the amount of Ozone in the Upper Atmosphere.

The amount of ozone in the lower atmosphere is negligible, but in 1920 Fabry and Buisson found by spectroscopic methods that in the upper atmosphere ozone is present to an amount equivalent to a layer of pure gas three millimetres thick at normal temperature and pressure. The present paper deals with the results of measurements on about eighty days, with a simple spectroscopic apparatus designed to give a ready measure of the brightness of the spectral lines. Comparison of the results with barometric pressure at the surface shows that the amount of ozone is much greater under cyclonic than under anticyclonic conditions, and there are indications that the amount is still more closely connected with the conditions at about 10 km. and with the height of the base of the stratosphere.

J. Baxendall—Meteorological Periodicities of the order of a few years and their local investigation; with special reference to the term of 5·1 years in Britain.

Mr. Baxendall adopts as his criteria of the reality of a periodicity its appearance in the harmonic analysis of each of several

meteorological or quasi-meteorological records, and, where any of these records are sufficiently lengthy, its appearance at very nearly the same phase in each half of the record. He has found in the British Isles six definite meteorological periodicities between the limits of $1\frac{1}{2}$ and $6\frac{1}{2}$ years which satisfy these criteria, namely those of 5·1, 3·1, 2·8, 2·4, 2·2 and 1·63 years. Other periodicities which are well-supported but which are not dominant in the British Isles are those of 6·2, 5·6, 4·8, 4·37, 3·98, 2·55 and 1·9 years. The various records in which these have been found by different investigators are discussed and their possible relations to one another pointed out. The greater part of the paper deals with the periodicity of 5·1 years, which was first found at Southport and which is particularly intense in the north-west of England, but which occurs also in the records from London, in the wheat prices of western Europe, and in the velocity of the south-east trade wind at St. Helena. This periodicity is particularly well shown in the duration of winds from north or north-east both at Southport and Greenwich and in the phenomena, such as severe winters, which depend on these winds.

Correspondence

To the Editor, *The Meteorological Magazine*

Isle of Wight Weather in the 17th Century

In reference to the article in the June issue of this magazine respecting variations in the rainfall of Great Britain, it may be well to put on record the following statement in regard to rainfall in the Isle of Wight in 1648. The note was written by Sir John Oglander, who was deputy-lieutenant of the Island at that time, and the manuscript is now at Carisbrooke Castle Museum. I am not aware that it has been published, excepting in a local newspaper. The original spelling, punctuation, etc., is followed. It reads:

> "In a booke of myne wherein Parliament Busines is wryghten, you may see that I have wryghten downe all the passages of note since his Matie came into our Island. This Sommer of the Kinges beinge here 1648: wase more like winter then Sommer, for his Matie asked me wheather that weather wase usual in our Island I tolde him this 40 years I never knew the like before, wee had scarse 3 drie dayes togeather but rayne hygh windes & stormes. In Awgust we had not one drye daye, so that the corne wase like to rotte in ye ground. Deus avertat."

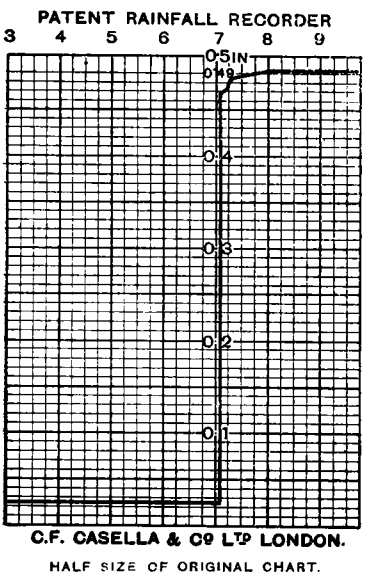
Another note by the same observer, published in the *Oglander Memoirs*, W. H. Long, 1888, runs:

> " 1627. Owre harvest, by reason of ye coldness of ye summor, and ye greate fall of rayne in August and September, wase not inned till Michaelmasse, and soome long after; mutch barlie wase spoyled, and almost all ye ffatches."

FRANK MOREY.

Newport, Isle of Wight. June 29th, 1925.

Rainfall of Very Rare Intensity



HALF SIZE OF ORIGINAL CHART.

IN your issue for March, I note Mr. F. J. Varley suggests that no recording apparatus has yet been designed which is not " smothered " by heavy rain. If by " smothered " he means that the actual trace on the chart follows materially after the rainfall, I think the enclosed photo tends to disprove this; for it shows an accurate record of the phenomenal fall of ·47 in. within 150 seconds. The fall occurred during a terrific thunderstorm at 7.5 p.m. on July 14th, 1917, and the slight curve at the top of the trace was merely due to a few hailstones which took some little time melting, hardly a matter for surprise as some of the hailstones I measured on the ground were nearly 4 inches in circumference and over an inch in diameter. The trace on careful measurement exactly confirms independent observation that the storm lasted just 2½ minutes, and the quantity gauged was exactly confirmed by an ordinary " Snowdon " rain gauge a few feet away.

JOHN H. WILLIS.

Southwell Lodge, Ipswich Road, Norwich. May 8th, 1925.

[A brief description of this storm is to be found in *British Rainfall*, 1917, p. [34], and a description of the Casella Patent Rainfall Recorder used, in *The Rainfall of the British Isles* by M. de C. S. Salter, p. 72.—ED. *M.M.*]

The Snowless Winter of 1924-925

DURING the past winter the ground has not once, even for a few minutes, been white with snow at this station (200 ft.), a thing unparalleled in my recollection. Snow has never lain below 700 ft.

What makes this even more remarkable is that this is not a flat district, and in about half an hour's walk one can stand at 1,200 ft.

Above 2,000 ft. there has been a considerable amount of snow although it was practically confined to the month of February. The Black Mountains were continuously pure white above 2,100 ft. from February 11th to March 6th with twelve to eighteen inches of snow. All of this came with winds from south to northwest and much drifting occurred even when no snow was falling, the snow blowing off the flat summit plateau (2,600 ft.) into the corries on the northeast side about 2,300 ft. So huge were the cornices in these corries that on visiting them on March 19th, I found that a small avalanche had occurred in one place. Although March and April provided nothing to augment the drifts—only occasional light sprinklings on the tops—one of the drifts was still visible from here, 14 miles, on May 6th, so we may assume that those formed in February lasted at 2,300 ft. till at least the second week in May.

It would be interesting to know the date of the disappearance of the late Mr. J. R. Gethin Jones' "Latest Snow Spot" on Carnedd Llewelyn.* Doubtless this will not be before mid-June, though in 1912 I remember it melted on May 8th, the day I visited it with Mr. Jones.

My "Weather Correspondent" at Fort William, who reports to me monthly, writes under date, May 4th, that the snow level on Ben Nevis was about 2,000 ft. and that the depth on the summit was about 15 ft., which I believe is a greater depth than was ever recorded while the Observatory was in existence.

I may add that I went up the Black Mountains again on May 12th and found the last bit of the drift in a corrie 3 yds. by 2 yds. by 1 foot deep; it probably melted on May 14th or 15th. The temperature at 2,660 ft. was 49° (when sun in) and maximum here as high as 65°. The 2,660 ft. temperature was taken at 3.15 p.m. (B.S.T.). R. P. DANSEY.

Kentchurch Rectory, Hereford. June 6th, 1925.

[The Rev. R. P. Dansey has since informed us that this year the "Latest Snow Spot" on Carnedd Llewelyn was visible from 18 miles distant until June 15th. Mist on the hills then supervened, and on the 19th there was no snow to be seen from that distance. Ed. *M.M.*].

Are Winters Changing?

I HAVE read with a good deal of interest the letter of Chas. Harding, headed "Are Winters Changing," and I was present at the meeting he refers to when Sir Richard Gregory gave his able presidential address on "British Climate in historic times."

* *Symons's Meteorological Magazine*, 54 (1919), p. 66, and *British Rainfall*, 1909, p. 46.

In that address he dealt not only with average temperature but also with the practical effects of severe winters in the production of ice. It seems to me that this is a true measure of the severity of the coldest spell of weather in each winter. Sir Richard Gregory gave particulars of years when the Thames had been frozen over and also of the number of days in certain winters when there had been skating ice on the waters of the London Skating Club.

We have in the area of the great Fenland of England a rough and ready means of comparison in the power of ice production of the winters say for the 25 years ending 1895 and the 25 or 30 years since 1895. The fact to which I would invite the attention of meteorologists is that, during the 25 years ending 1895, all the main rivers in the Fenland bore on several occasions. The ice on them was sometimes so strong that skating matches attended by many thousands of skaters were run on them. Whereas since 1895 none of them, with the possible exception of the Welland, have afforded good skating ice for more than 3 or 4 consecutive days, if even so much.

I have records as under :—

1870-71—Skating match on the Ouse at Littleport.
1874-75—Skating on the Hundred Foot and a skating match on the Ouse at Huntingdon.
1879-80—Splendid skating on the Hundred Foot.
1880-81—Skating on the Cam and Ouse from Cambridge to Denver Sluice (33 miles).
Skating on the Witham, Boston to Lincoln (about 31 miles).
Skating on the Welland, Crowland to Spalding.
1890-91—Skating on the Cam and Ouse, Cambridge to Denver Sluice.
Skating on the Witham, Boston to Lincoln.
Skating on the Nen, Peterborough to Guyhirne.
1894-95—Skating on the Cam and Ouse, Cambridge to Denver Sluice.
Skating on the Nen, Peterborough towards Guyhirne.

The above records are not complete.

After making all allowance for variation in the strength of the current in different seasons, the conclusion seems inevitable — that the spells of cold in the skating months December, January and February, were much more severe in the quarter of a century ending 1895 than in the succeeding quarter of a century. Indeed during the latter period, opportunities for skating have been so few that large numbers of the younger generation have not learned to skate well.

S. SOUTHALL BURLINGHAM.

81, *High Street, King's Lynn. June 21st,* 1925.

WITH reference to the letter headed "Are Winters Changing," Mr. A. H. Hookham, of Eastbourne, has pointed out that it is not sufficient to take mean temperatures only, but that maximum

and minimum temperatures should be considered separately before arriving at a definite conclusion. From the following table it will be seen that, in the winter months, the maximum temperature at Eastbourne has increased during the 30 years under consideration and that in the summer months the minimum temperature has decreased. If mean temperatures only were considered the latter fact would be masked. The sea temperatures also show a tendency to increase in the winter and decrease in the summer.

10 years average.	Winter Months.			Summer Months.		
	Max.	Min.	Sea.	Max.	Min.	Sea.
1892-1901	49·1	40·0	46·2	62·6	51·3	58·1
1902-1911	49·3	40·2	46·2	61·6	50·3	57·3
1912-1921	49·8	40·2	46·6	62·9	50·5	57·5

NOTES AND QUERIES

The Dry June of 1925

THE rainfall of June, 1925, was below the average everywhere except in the extreme north of Scotland. The deficiency was most marked in England and Wales and in Ireland where falls of 1 in. or more were confined to high land in the English Lake District, Connemara and the counties of Londonderry, Tyrone and Donegal. Over large areas in the southern half of England and Wales no measureable rain fell during the 32 days beginning on May 30th. The area with no rainfall in June appears to have been confined to England and Wales south of the latitude of Birmingham and to the west of a line from Brighton to Bedford.

At Camden Square (London) the fall of ·11 in. was the least amount recorded there in June since the record began in 1858, and the driest month since April, 1912, when only ·04 in. fell. The Rev. R. P. Dansey, of Kentchurch Rectory, Hereford, recorded his "first rainless month in 31 years' observations in Herefordshire and Shropshire." He draws attention to the fact that "the rivers did not get so low as on several previous occasions nor was the country so dried up, the year's rainfall up to the end of June being still 0·66 in. in excess of the average." The following notes from observers indicate the abnormality of the rainfall of the month: It was the driest June at Slough in Buckinghamshire in 52 years, and at St. Michael's on Wyre in Lancashire in 50 years. It was the driest calendar month at

Wolstaston Rectory in Shropshire in 60 years' record, at Newcastle in 57 years, at Mickleover, near Derby, in 55 years, and at Bramley, in Hampshire, in 54 years.

The fall for the month was less than 10 per cent. of the average over the whole of England and Wales, with the exception of part of the extreme north and the south-eastern counties from the Wash to Beachy Head, and also along the east coast of Ireland. The fall nowhere exceeded half the average in England and Wales and only locally in Ireland in the neighbourhood of Londonderry. In Scotland the percentage values increased fairly regularly from about 10 per cent. in the south to 118 per cent. at Achfary in Sutherlandshire. In the Thames Valley some rain fell generally on the 24th and 26th. The total fall for the month amounted to ·12 in. or 5 per cent. of the average. This constitutes a record for June for the Valley as a whole since comparable statistics became available in 1883, and the driest month since April, 1912, when the general fall was ·06 in.

So far as can be ascertained from the information already available the rainfall of June, 1925, over the British Isles as a whole was less than in June, 1921, and ranks about equal with that of the record dry month February, 1891. A similar statement holds for England and Wales. In Scotland the month was probably not as dry as July, 1913, and several other earlier months. In Ireland June, 1921, was drier. By the end of June the " absolute drought " had not equalled that of the famous spring drought of 1893 when in parts of Kent and Sussex no rain was measured for a period of 50 days. J.G.

The Comparison of Rainfall at Neighbouring Stations

In preparing rainfall statistics it is often necessary to calculate a normal for a given station for a longer period than is covered by the available observations. For example, an average rainfall map is being prepared for the period 1881 to 1915, and at one station, which we will call " A," observations did not commence until 1891. The recognised procedure in such cases is to select one or more neighbouring stations at which observations were taken over the full period, and to assume that the ratio between the annual or monthly rainfall at station " A " and that at the comparison stations is constant. This assumption is sometimes called Hann's Law. In our example we may suppose that at the comparison stations the average rainfall during the period 1891 to 1915 was 20·0 in. and that between 1881 and 1915 21·0 in. The average rainfall at station " A " for 1891 to 1915 is then multiplied by 21·0/20·0 and the result is considered to represent the average at station " A " for the period 1881 to 1915.

The validity of this process depends on the correctness of the assumption mentioned above, that the ratio between the rainfall

at "A" and at the comparison stations is constant. Hann* himself quotes annual figures for Lucerne and Basle which are nearly fifty miles apart and continues "One sees that the variations of the annual rainfall in general run parallel and that one may accordingly assume that the rainfall of a place between Lucerne and Basle or especially in the neighbourhood of one of these stations would similarly take part in the same variations." This assumption has worked well in practice in this country, in that it has never led to any obvious errors, but apparently it has never been categorically confirmed. For the two Scottish stations of Fort Augustus and Glenquoich a test shows that it is not strictly true. Fort Augustus lies at a height of 68 feet at the south-western end of Loch Ness, and Glenquoich, at a height of 569 feet, is 25 miles to the west-southwest. For the period 1884 to 1918 the average annual rainfall at Glenquoich was 2·51 times that at Fort Augustus, and according to the principle of proportionality, we should write—

Glenquoich rain = 2·51 × Fort Augustus rain...I.

For the two dry years 1889 and 1915, however, the ratio was 2·65, and for the two wet years 1903 and 1916 it was 2·25. A calculation by the method of least squares shows that the rainfall at Glenquoich can be derived from that at Fort Augustus more accurately than by the method of direct proportionality, if we write

Glenquoich rain = 1·64 × Fort Augustus rain + 39·0 in....II.

There are more raindays at Glenquoich than at Fort Augustus, and the additive figure of 39·0 in. presumably represents the days on which little or no rain fell at the latter station, while at the former the amount was appreciable.

In winter the relation between the two stations is similar to that for the year. Thus, for January:

Glenquoich rain = 1·91 × Fort Augustus rain + 3·74 in.

In summer, on the other hand, Hann's Law is very nearly correct; for July:

Glenquoich rain = 2·52 × Fort Augustus rain — 0·86 in.

The rainfall at Glenquoich for the two wet years 1903 and 1916, calculated from those at Fort Augustus by formula I are respectively 14 and 18 in. too high, while by formula II the errors are only — 4·8 and + 5·8 in. It seems that at the two stations compared a considerable improvement in the accuracy of interpolated values would be obtained by a modification of the assumption of direct proportionality. In this particular example the sites of the stations differ widely; at two stations similarly situated in an open plain with approximately the same number of raindays it is quite possible that the additive term would be very small, but the test, which takes very little time,

* Lehrbuch der Meteorologie, 3rd edition, p. 336.

would be worth making as a preliminary to all reductions from one station to another.

Unusually Severe Weather in 1684

IN the series of extracts, entitled "Early Science at Oxford," now being published in *Nature*, the following appeared in the issue for February 7th, 1925:—

> "*February* 10*th*, 1684/5. That Mr. Maunders, chaplain to Col. Luttrel, in Dorsetshire, Mr. Thomas, minister of Chard, and Dr. Tubervile of Salisbury, be asked what information they can give of ye late cold wind, which proved so fatal in Wiltshire, and Dorsetshire, about last Christmas."

Nature for March 7th, 1925, contained the sequel:

> "*March* 10*th*, 1684/5. Mr. Maunders speaking of ye dismall weather on ye 23rd of December last, says, that above eighty Persons were found killed by it, in Wiltshire and Dorsetshire. Some died suddenly, others by degrees: some, that escaped, were so tormented in their hands, and face (parts exposed to ye cold) that, as they recovered, and ye swellings abated, the skin peeled off, and they were some days without ye use of their limbes, and sometimes of their senses."

This exceptional occurrence is not recorded by Lowe in his *Natural Phenomena and Chronology of the Seasons*, nor is it mentioned by Sir Richard Gregory in *British Climate in Historic Times*. It would be interesting to know whether any records still exist which would throw further light on weather which appears to have been so exceptional for this country.

A Lost Opportunity

ON November 2nd, 1924, about 22h. 55m. a splendid meteor was seen in the western sky from Somerset and Devonshire. Many persons witnessed the outburst, which was of dazzling intensity and lit up the countryside with vivid effect. The fireball passed to the north-west, its luminous course began, when over Bude, at a height of about 69 miles, and it travelled seawards, disappearing far to the west of Lundy Island. A few minutes following the apparition, a loud and somewhat alarming detonation was heard by a number of people in the district near which the meteor passed. According to Mr. W. F. Denning, who is our greatest expert in such matters, there is no doubt but that the noise was occasioned by the explosion and disruption of the object. Unfortunately, few of the people who saw the apparition or heard the explosion made notes of the time, and Mr. Denning can only say that the interval between sight and sound averaged about 5 minutes.

Near the village of Hilton in Derbyshire, on April 4th, 1925, a bright red ball of fire was seen in the south-western sky about 21h. 40m. The whole countryside was lit up, and surrounding trees, fields and other objects could be seen as though it were daylight. The ball when first observed was at an angle of elevation of about 50°. As it fell it turned a light shade of green then dull red and disappeared. Altogether it lasted about 8 seconds. These facts were reported by two independent observers.

The object of this note is to point out that wireless has made the accurate timing of widespread observations a possibility. If a dozen of the people who saw the meteor on November 2nd had listened for the arrival of the sound, and noted the time to a second, information of great value would have been secured. The information is required because it would enable reliable estimates of the temperature at great heights to be made, for the time of travel of sound depends on the temperature of the air. There is good evidence that the average temperature 30 miles above ground is actually higher than in parts of the atmosphere with which we are familiar. Such a paradoxical idea should be tested as much as possible, and the timing of meteoric explosions is likely to provide one of the best tests. Some day we shall make our own explosions by sending up powerful rockets, but meanwhile use should be made of the opportunity presented to us by nature. This is one of the ways in which the great public which enjoys broadcasting can repay its debt to science.

A few words about time-keeping may not be out of place. In an ordinary watch or clock the seconds hand goes on steadily whilst the minute hand and hour hand are being set. If an attempt is made to set the minute-hand to the correct time, it will generally be found that the seconds hand and minute hand get out of step. If the hour hand is between II. and III. and the minute hand a third of the way from 33 to 34, whilst the seconds hand is at 49, what is the time by your watch? The best plan is to set the minute hand to be in step with the seconds hand. When you learn from the time-signal that your watch is 2 minutes 42 seconds fast, put the minute hand back 2 minutes and note that the watch is now 42 seconds fast. If you are systematic, you will note it in your diary. When you have made an observation of importance, check the error of the watch at the first opportunity, and if you are reporting the observation, give the time of the observation itself according to your watch, and also the errors of the watch as given by the time signals before and after the observations. The Greenwich Time Signal consists of six dots, the last of which marks the exact time. Mr. J. P. M. Prentice, of Redcroft, Stowmarket, Suffolk, is

Director of the Meteor Observing Section of the British Astronomical Association, and would be glad to have records of the time and bearing of all meteors, not only of the audible ones, though these are the more interesting at the moment.

St. Helena

Mr. A. L. C. Hands, the veteran observer at St. Helena, who has read the instruments daily and cared for the anemometer at that station for nearly thirty-four years is retiring. The station is near the summit of a hill, at a height of about 2,000 feet, and Mr. Hands, who has been suffering from ill-health lately, finds himself unable to continue this arduous climb in all weathers. The isolated station at St. Helena, situated in the south Atlantic " centre of action," has proved of great value in investigations of the meteorology of the globe and Mr. Hands has performed a great service for the science. There was at one time some fear that a successor would not be forthcoming and it is satisfactory to report that this fear has proved groundless. The observations will be carried on by Captain J. P. Mainwaring, late R.E.

Weather and Sugar Crops

In 1909 Mr. A. Walter, Director of the Royal Alfred Observatory, Mauritius, published a valuable study of the influence of meteorological conditions on the sugar crop of Mauritius. In this investigation the crops were correlated with a " wetness factor " formed by multiplying the mean daily rainfall by the number of rain days. Since it was realised that rainfall above a certain amount cannot have a proportional effect, an arbitrary limit of 0·50 in. per day was adopted, and the year 1896, in which the average rainfall exceeded this amount, was ignored. The crude rainfall figures gave a correlation coefficient of + 0·52 with crops, and the " wetness factor " a coefficient of + 0·70.

Mr. Walter has since continued his investigations, and now gives us the first part of his later results.* For the arbitrary " wetness factor " he has substituted the actual amount of moisture in the soil, determined by a series of experiments on the rate of drying of samples of soil under field conditions. From this curve of drying and the daily rainfall the moisture-content was calculated for each day during the whole period, 1892 to 1905, and the annual averages were correlated with the crops. The effect of temperature was also included, and partial correlation coefficients were obtained : crop-soil moisture (temperature

* Mauritius, Royal Alfred Observatory, Miscellaneous Publications, No. 5. *The Relation between sugar crops and weather.* By A. Walker, Port Louis, 1922.

constant), + 0·827; crop – temperature (soil moisture constant), + 0·310. This represents a great advance on the original "wetness factor," and, by discussing the soil moisture during each two-monthly period separately, a further improvement was obtained. From the amounts by which the observed crops fell below the calculated crops during four years in which the island was visited by cyclones, a complicated expression is derived for the damage done to the crops by winds exceeding forty miles an hour. The formulæ thus give a method of calculating the crop from the rainfall, temperature and wind velocity. The author recognises that the period of fourteen years is too short for completely reliable results, but after 1905 changes were introduced in the cultural conditions. The years 1905 to 1917 are being dealt with in a further memoir, and then the results for the whole period will be summarised.

Apia Observatory

FROM time to time brief accounts of the extension of the work carried out by the Apia Observatory (western Samoa) have appeared in the *Meteorological Magazine*. About two years ago it was made the headquarters of a weather service for the western Pacific. Now in response to the appeal for more rapid publication of meteorological data, a monthly summary containing daily and monthly values of pressure, temperature, precipitation, etc., at the Apia Observatory is being issued within a few days of the end of each month. The summaries started in January, 1925, and the Director, Mr. Thomson, is to be congratulated on the amount of meteorological detail concerning the Observatory which is received on the other side of the world in so short a time.

The Publication of Observations Made at the Observatories of the Meteorological Office

THE attention of librarians is called to the fact that the series of volumes published under the title *British Meteorological and Magnetic Yearbook* terminates with the issues for the year 1921. The *Weekly Weather Report* and the *Monthly Weather Report* are now regarded as separate publications. It has been mentioned previously that Observations at Stations of the First and Second Order, Part III., Section I., of the Yearbook has been discontinued. The Geophysical Journal and Hourly Values from Autographic Records, *i.e.*, Part III., Section II., and Part IV., of the *Yearbook* are being amalgamated in a single publication, to which the title *The Observatories' Year Book* has been assigned. The first volume of the new series, that giving data for 1922, is now in the press and will appear shortly.

Review

Die Ergebnisse der meteorologischen Beobachtungen der Deutschen Antarktischen Expedition 1911-1912. By E. Barkow. Edited by K. Knoch. (Veröff. Preuss. Met. Inst. Abh. vii. 6.) 4to., 13 × 10, pp. x. + 166. Berlin : Behrend and Co. 1924.

HERR BARKOW, the meteorologist on Filchner's expedition of 1911-12 to the Weddell Sea on the *Deutschland*, was engaged in the discussion of the meteorological data collected on the voyage when he died in 1923, and the work has been completed by Herr Knoch. Difficulties of publication have compelled a severe condensation of the original discussion and it may be on this account that the data have been dealt with throughout as if they had been obtained at a fixed station instead of on a ship sailing southward and then drifting northward in an ice-encumbered sea through some twenty degrees of latitude, the Antarctic circle coming nearly midway between the extreme positions. By dealing with monthly and seasonal means, irrespective of position, the authors certainly escape the main difficulty which confronted them, but at the same time their results lose much of their value from the regional point of view. Attention might well have been called more prominently to the fact that while the data for December, 1911, and December, 1912, came from the positions north of 63° S, January, 1912, between 62° and 77° S, those for February came almost entirely from south of 75° S, those for March to July from 75° to 70° S, and those for August to November between 70° and 63° S. Probably the March to July results are the most homogeneous and give a fair idea of the meteorological conditions of the Weddell Sea in winter. It is to be deplored that the meteorology of the *Deutschland* and of the *Endurance* could not have been worked up together ; but on the other hand the discussion of Shackleton's results to which we look forward will be greatly helped by the careful elaboration of Filchner's work now before us.

The daily and yearly march of pressure, temperature, humidity, wind and clouds is dealt with systematically and the duration of sunshine, the duration and amount of precipitation and the temperature of the floe-ice at various depths are also set forth in monthly and seasonal tables. The excellent series of upper air observations by means of kites, captive and pilot balloons were a valuable part of the meteorological work of the expedition and are treated in considerable detail. There is also a daily weather summary, and the memoir concludes with a short dissertation on the circulation of the atmosphere in the Antarctic.

Throughout the discussion of the data reference is made to the work of the *Gauss*, to Nordenskjöld's observations at Snow

Hill and to Amundsen's at Framheim; but when this part of the work was being dealt with Dr. Simpson's report on the meteorology of the *Terra Nova* expedition was not available, and is only referred to by notes added on revision. In the section on Atmospheric Circulation, however, Dr. Simpson's work was fully utilized and the authors do not hesitate to accept his conclusions in many cases in preference to those of their countryman Meinardus.

Herr Barkow thus summarizes his view of Antarctic atmospheric circulation—"The circulation over the Antarctic continent is dominated by an anticyclonic cap of air which probably flows outward in a series of waves moving in a south to north direction. Above this cap of cold air there is a cyclonic stratum connected with the circulation of temperate latitudes and in this wandering depressions travel in a west to east direction. The two air-systems mutually influence each other; on the whole the lower system dominates the upper at least so far as atmospheric pressure is concerned. The surface winds are dominated on the whole by the lower system for the most part on the continent and in less degree as the distance from land increases. In the Cirrus region, and especially in the stratosphere, cloud movements appear to show that there is a current of air moving right across the continent from the Indian Ocean to the region of the West Antarctic as indicated by the northern component of cirrus-movement in the former region and the southern component in the latter." Herr Barkow says that he concurs in Professor Hobb's conception of the formation of a south polar glacial anticyclone.

The Prussian Meteorological Institute is to be congratulated on bringing out this memoir in spite of difficulties of compilation and printing more serious even than the difficulties of the polar ice which forced the *Deutschland* so far from the path laid down "according to plan."

HUGH ROBERT MILL.

The Weather of June, 1925

THE outstanding feature of the weather of June was the scarcity of rainfall; less rain being measured in England and Wales than in the record dry June of 1921. In many districts in south-west and south England and south Wales there was no rain at all. During the first few days of the month depressions near Iceland caused moderate to fresh west to south-west winds over the greater part of the British Isles, with slight showers of rain in the south and slight to moderate rain in the north: 17 mm. were measured at Eskdalemuir (Dumfries) on the 2nd, and at Achnashellach (Ross-shire) both on the 1st and 2nd. Ground

frosts were experienced in some parts, a grass minimum temperature of 26° F. being recorded at Rounton (York) on the 2nd. The ridge of high pressure however, extending from the Azores, spread gradually north-eastwards, and by the 4th an anticyclone lay over England and the Netherlands. Temperature rose considerably, and for about a fortnight warm sunny weather prevailed. Readings above 80° F. occurred in many places, 88° F. being reached at London (Camden Square) on the 11th, and 86° F. as far north as Durham on the 10th. At Eskdalemuir 82° F. on the 10th was the highest reading taken there in June since records began in 1910. Between 14 and 15 hours of bright sunshine were experienced on most days, and as much as 16·0 hours were registered at Stornoway on the 8th. Mist and fog occurred on several days along the east coast of Great Britain. Meanwhile, the anticyclone, after having passed to Scandinavia, had begun to withdraw westwards to the Atlantic. On the 13th to 14th a depression moved south-eastwards from Iceland to the Baltic, and cool northerly breezes were associated with a temporary drop in temperature. On the 15th the winds backed to west and temperature again rose above 80° F. in a few places, but by the 17th pressure had increased near Iceland and north-west to north winds prevailed during the next ten days. Warm sunny weather continued to be experienced generally in the western districts of Great Britain—78° was the maximum at Kilmarnock on the 24th—but in the eastern districts the weather was cloudy and cool, especially on the 24th, when a maximum temperature of 49° F. was recorded at Rounton (York). Slight rain occurred locally, the largest measurements being registered on the east coast. Between the 27th and the 30th the anticyclone passed southwards across the British Isles and the weather became generally fine and warm. In north-west Scotland and north-west Ireland, however, much cloud developed, and rain fell locally. Total sunshine for the month reached record figures in several places. At Falmouth Observatory, 375 hours exceeded all previous records there by nearly 30 hours.

Pressure was above normal over the western coasts of Europe, the British Isles, the greater part of the North Atlantic and at Spitsbergen, the excess exceeding 5 mb. over Ireland and western England. Over the greater part of Scandinavia, Iceland, Jan Mayen and the western Mediterranean pressure was somewhat below normal. This distribution favoured northerly winds over the North Sea and the adjacent coasts. Temperature was generally about normal over western Europe but more than 2° F. in excess in the extreme north. With the exception of northern Scandinavia the rainfall over western Europe was very scanty, the deficit amounting to 90 mm. at Zurich, 54 mm. at

[*continued on p.* 156

Rainfall: June, 1925: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square.....	·11	3	5	*War.*	Birminghm, Edgbaston	·34	9	15
Sur .	Reigate, Hartswood...	·10	3	5	*Leics*	Thornton Reservoir ..	·03	1	1
Kent.	Tenterden, View Tower	·18	5	9	,, .	Belvoir Castle.....	·13	3	7
,, .	Folkestone, Boro. San.	·54	14	...	*Rut .*	Ridlington.....	·06	1	...
,, .	Broadstairs, St. Peter's	·72	18	41	*Linc.*	Boston, Skirbeck	·20	5	11
,, .	Sevenoaks, Speldhurst.	·22	6	...	,, .	Lincoln, Sessions House	·05	1	2
Sus .	Patching Farm.....	·09	2	4	,, .	Skegness, Estate Office.	·13	3	7
,, .	Brighton, Old Steyne .	·08	2	5	,, .	Louth, Westgate	·08	2	4
,, .	Tottingworth Park....	·22	6	10	,, .	Brigg	·06	1	3
Hants	Ventnor, Roy. Nat. Hos.	·00	0	0	*Notts.*	Worksop, Hodsock....	·11	3	6
,, .	Fordingbridge, Oaklnds	·01	0	1	*Derby*	Mickleover, Clyde Ho..	·08	2	3
,, .	Ovington Rectory	·00	0	0	,, .	Buxton, Devon. Hos...	·17	5	5
,, .	Sherborne St. John Rec.	·00	0	0	*Ches.*	Runcorn, Weston Pt...	·02	1	1
Berks	Wellington College...	·00	0	0	,, ..	Nantwich, Dorfold Hall	·05	1	...
,, .	Newbury, Greenham..	·00	0	0	*Lancs*	Manchester, Whit. Pk.	·06	1	2
Herts.	Bennington House....	·32	8	16	,, ..	Stonyhurst College....	·27	7	9
Bucks	High Wycombe	·00	0	0	,, ..	Southport, Hesketh...	·07	2	3
Oxf..	Oxford, Mag. College..	·05	1	2	,, ..	Lancaster, Strathspey.	·49	12	...
Nor .	Pitsford, Sedgebrook..	·00	0	0	*Yorks*	Sedbergh, Akay	·35	9	11
,, .	Eye, Northolm.....	·08	2	...	,, .	Wath-upon-Dearne ...	·12	3	5
Beds.	Woburn, Crawley Mill.	·06	1	3	,, .	Bradford, Lister Pk...	·08	2	3
Cam.	Cambridge, Bot. Gdns.	·43	11	20	,, .	Wetherby, Ribston H..	·00	0	0
Essex	Chelmsford, County Lab	·38	10	20	,, .	Hull, Pearson Park ...	·05	1	2
,, .	Lexden, Hill House...	·30	8	...	,, .	Holme-on-Spalding ...	·09	2	...
Suff .	Hawkedon Rectory ...	·58	15	28	,, .	West Witton, Ivy Ho..	·09	2	...
,, .	Haughley House.....	·45	11	...	,, .	Felixkirk, Mt. St. John	·10	3	5
Norf.	Beccles, Geldeston....	·74	19	41	,, .	Pickering, Hungate ...	·03	1	...
,, .	Norwich, Eaton	·61	15	32	,, .	Scarborough.....	·18	5	10
,, .	Blakeney	·62	16	33	,, .	Middlesbrough	·08	2	4
,, .	Swaffham	·64	16	30	,, .	Baldersdale, Hury Res.	·09	2	4
Wilts.	Devizes, Highclere....	·10	3	4	*Durh.*	Ushaw College	·23	6	11
,, .	Bishops Cannings	·07	2	3	*Nor .*	Newcastle, Town Moor.	·04	1	2
Dor .	Evershot, Melbury Ho.	·07	2	3	,, .	Bellingham, Highgreen	·16	4	...
,, .	Weymouth, Westham..	...	..	...	,, .	Lilburn Tower Gdns...	·13	3	...
,, .	Shaftesbury, Abbey Ho.	·02	1	1	*Cumb*	Geltsdale.....	·45	11	...
Devon	Plymouth, The Hoe...	·01	0	0	,, .	Carlisle, Scaleby Hall .	·29	7	12
,, .	Polapit Tamar	·01	0	0	,, .	Seathwaite M.....	·46	12	7
,, .	Ashburton, Druid Ho..	·00	0	0	*Glam.*	Cardiff, Ely P. Stn.....	·06	1	2
,, .	Cullompton	·20	5	9	,, .	Treherbert, Tynywaun	41	10	...
,, .	Sidmouth, Sidmount ..	·04	1	2	*Carm*	Carmarthen Friary....	·02	1	1
,, .	Filleigh, Castle Hill ...	·01	0	...	,, .	Llanwrda, Dolaucothy.	·08	2	2
,, .	Barnstaple, N. Dev. Ath.	·00	0	0	*Pemb*	Haverfordwest, School	·00	0	0
Corn.	Redruth, Trewirgie ...	·00	0	0	*Card.*	Gogerddan.....	·05	1	2
,, .	Penzance, Morrab Gdn.	·00	0	0	,, .	Cardigan, County Sch. .	·03	1	...
,, .	St. Austell, Trevarna..	·03	1	1	*Brec .*	Crickhowell, Talymaes	·10	3	...
Soms	Chewton Mendip	·01	0	0	*Rad .*	Birm. W. W. Tyrmynydd	·11	3	3
,, .	Street, Hind Hayes ...	·06	1	...	*Mont.*	Lake Vyrnwy	·00	0	...
Glos..	Clifton College	·00	0	0	*Denb.*	Llangynhafal	·10	3	...
,,	Cirencester	·13	3	5	*Mer .*	Dolgelly, Bryntirion..	·19	5	5
Here.	Ross, Birchlea	·00	0	0	*Carn.*	Llandudno	·08	2	4
,, .	Ledbury, Underdown.	·00	0	0	,, .	Snowdon, L. Llydaw 9	·57	15	...
Salop	Church Stretton.....	·03	1	1	*Ang .*	Holyhead, Salt Island.	·05	1	2
,, .	Shifnal, Hatton Grange	·03	1	1	,, .	Lligwy	·01	0	...
Staff.	Tean, The Heath Ho...	·07	2	3	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	·05	1	2		Douglas, Boro' Cem...	·11	3	4
,, .	Blockley, Upton Wold.	·21	5	8	*Guernsey*				
War.	Farnborough.....	·10	3	4		St. Peter P't, Grange Rd	·00	0	0

Rainfall: June, 1925: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	·42	11	17	*Suth.*	Loch More, Achtary...	4·37	111	118
,, .	Pt. William, Monreith .	·43	11	...	*Caith*	Wick	1·36	35	76
Kirk.	Carsphairn, Shiel.	·47	12	...	*Ork .*	Pomona, Deerness	1·46	37	79
,, .	Dumfries, Cargen.....	·23	6	8	*Shet .*	Lerwick	1·00	25	56
Dum	Drumlanrig	·31	8	13					
Roxb	Branxholme	·68	17	30	*Cork.*	Caheragh Rectory	·50	13	...
Selk .	Ettrick Manse.....	·85	22	...	,, ..	Dunmanway Rectory.	·48	12	14
Berk.	Marchmont House	·28	7	12	,, ..	Ballinacurra	·43	11	16
Hadd	North Berwick Res....	·70	18	42	,, ..	Glanmire, Lota Lo. ...	·70	18	26
Midl	Edinburgh, Roy. Obs..	·46	12	24	*Kerry*	Valencia Obsy.	·31	8	10
Lan .	Biggar	·36	9	17	,, .	Gearahameen	·20	5	...
Ayr .	Kilmarnock, Agric. C..	·44	11	20	,, .	Killarney Asylum.....	·27	7	9
,, .	Girvan, Pinmore.....	·55	14	19	,, .	Darrynane Abbey	·28	7	9
Renf.	Glasgow, Queen's Pk..	·35	9	15	*Wat .*	Waterford, Brook Lo..	·42	11	16
,, .	Greenock, Prospect H..	1·53	39	46	*Tip .*	Nenagh, Cas. Lough...	·70	18	29
Bute.	Rothesay, Ardencraig.	1·40	36	46	,, .	Tipperary	·49	12	...
,, .	Dougarie Lodge	1·20	31	...	,, .	Cashel, Ballinamona ..	·42	11	18
Arg .	Ardgour House	3·24	82	...	*Lim .*	Foynes, Coolnanes	·20	5	8
,, .	Manse of Glenorchy..	2·53	64	...	,, .	Castleconnell Rec.	·64	16	...
,, .	Oban	1·77	45	...	*Clare*	Inagh, Mount Callan ..	·34	9	...
,, .	Poltalloch				,, .	Broadford, Hurdlest'n.	·46	12	...
,, .	Inveraray Castle.....	2·07	53	52	*Wexf*	Newtownbarry	·50	13	...
,, .	Islay, Eallabus.....	1·67	42	64	,, .	Gorey, Courtown Ho...	·22	6	9
,, .	Mull, Benmore	5·30	135	...	*Kilk.*	Kilkenny Castle	·35	9	14
Kinr.	Loch Leven Sluice	·33	·8	15	*Wic .*	Rathnew, Clonmannon	·10	3	...
Perth	Loch Dhu	1·00	25	24	*Carl .*	Hacketstown Rectory .	·43	11	15
,, ..	Balquhidder, Stronvar.	·46	12	12	*QCo..*	Blandsfort House.....	·29	7	11
,, ..	Crieff, Strathearn Hyd.	·51	13	19	,,	Mountmellick	·50	13	
,, ..	Blair Castle Gardens ..	·50	13	25	*KCo .*	Birr Castle.....	·55	14	24
,, .	Coupar Angus School..	·35	9	19	*Dubl.*	Dublin, FitzWm. Sq...	·26	7	13
Forf.	Dundee, E. Necropolis.	·61	15	34	,, .	Balbriggan, Ardgillan .	·16	4	8
,, .	Pearsie House.....	·60	15	...	*Me'th*	Drogheda, Mornington	·33	8	...
,, .	Montrose, Sunnyside..	·74	19	45	,, .	Kells, Headfort.....	·55	14	21
Aber.	Braemar Bank	·45	11	24	*W.M*	Mullingar, Belvedere .	·79	20	30
,, .	Logie Coldstone Sch. ..	·67	17	34	*Long*	Castle Forbes Gdns....	·66	17	26
,, .	Aberdeen, Cranford Ho	·			*Gal .*	Ballynahinch Castle ..	·86	22	24
,, .	Fyvie Castle	1·12	28	...	*Mayo*	Mallaranny.....	1·72	44	...
Mor .	Gordon Castle.....	1·02	26	50	,, .	Westport House.....	·33	8	12
,,	Grantown-on-Spey....	·77	20	34	,, .	Delphi Lodge	1·67	42	...
Na .	Nairn, Delnies.....	·51	13	29	*Sligo*	Markree Obsy.	·75	19	26
Inv..	Ben Alder Lodge	1·22	31	...	*Cav'n*	Belturbet, Cloverhill..	·94	24	39
,, .	Kingussie, The Birches	·55	14	...	*Ferm*	Enniskillen, Portora ..	·58	15	...
,, .	Loch Quoich, Loan....	3·10	79	...	*Arm.*	Armagh Obsy.	1·08	27	43
,, .	Glenquoich	3·57	91	73	*Down*	Warrenpoint	·36	9	...
,, .	Inverness, Culduthel R.	·33	8	...	,, .	Seaforde	·22	6	8
,, .	Arisaig, Faire-na-Squir	2·90	74	...	,, .	Donaghadee, C. Stn...	·30	8	13
,, .	Fort William.....	1·83	47	52	,, .	Banbridge, Milltown .	·79	20	31
,, .	Skye, Dunvegan.....	1·60	41	...	*Antr.*	Belfast, Cavehill Rd. .	·60	15	...
,, .	Barra, Castlebay	·35	9	...	,, .	Glenarm Castle.....	·85	22	...
R&C	Alness, Ardross Cas. ..	·63	16	28	,, .	Ballymena, Harryville	1·23	31	42
,, .	Ullapool.....	1·77	45	...	*Lon .*	Londonderry, Creggan	1·57	40	56
,, .	Torridon, Bendamph..	2·60	66	64	*Tyr .*	Donaghmore	·94	24	...
,, .	Achnashellach	3·25	83	...	,, .	Omagh, Edenfel	·80	20	28
,, .	Stornoway	·98	25	42	*Don .*	Malin Head	·76	19	36
Suth.	Lairg	·88	22	...	,, .	Rathmullen.....	·69	17	...
,, .	Tongue Manse.....	1·68	43	82	,, .	Dunfanaghy	·62	16	22
,, .	Melvich School.....	1·03	26	53	,, .	Killybegs, Rockmount .	1·33	34	35

Climatological Table for the British Empire, January, 1925

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1024·3	+ 6·7	55	27	46 9	36·8	41·9	+ 3·0	39·1	90	8·3	45	0	15	1·2	15
Gibraltar	1029·8	+ 8·6	63	43	60 5	51·4	55·9	+ 1·1	49·9	78	6·7	3	−126	3	...	...
Malta	1028·3	+10·7	64	48	59·0	51·7	55·4	+ 0·1	49·1	72	5·6	32	− 50	12	6·0	61
Sierra Leone	1013·3	+ 2·1	91	65	88·3	69·7	79·0	− 2·5	70·0	63	2·1	0	− 11	0	...	...
Lagos, Nigeria	1009·8	− 0·1	89	63	86·8	70·1	78·5	− 2·5	67·6	69	5·1	38	+ 10	1	...	...
Kaduna, Nigeria	1017·4	+ 5·8	89	...	82·1	...	...	...	54·2	47	1·2	0	0	0	...	...
Zomba, Nyasaland	1006·0	− 2·5	85	61	80·2	64·5	72·3	− 0·4	...	92	9·5	391	+112	28	...	...
Salisbury, Rhodesia	1005·6	− 3·3	80	50	75·2	60·2	67·7	− 1·8	63·0	78	7·5	296	+ 95	25	4·4	34
Cape Town	1013·8	+ 0·6	89	49	79·6	59·8	69·7	− 0·1	62·5	70	2·4	15	− 3	4	...	...
Johannesburg	1009·8	− 0·8	84	46	75·4	55·3	65·3	− 0·9	58·1	72	5·6	129	− 30	17	7·3	54
Mauritius	1011·6	− 0·3	88	68	85·5	72·7	79·1	− 0·2	75·0	68	6·2	150	− 47	19	9·0	69
Bloemfontein	...	...	91	47	85·6	59·1	72·3	− 0·9	63·1	62	3·5	72	− 30	9	...	...
Calcutta, Alipore Obsy.	1012·8	− 2·4	82	47	75·5	56·0	65·7	− 0·7	56·5	86	4·0	19	+ 10	1*	...	...
Bombay	1011·9	− 1·7	86	56	81·1	65·2	73·1	− 2·2	61·4	68	1·9	0	− 3	0*	...	...
Madras	1011·8	− 2·3	88	60	84·1	66·0	75·1	− 1·0	69·9	88	3·8	34	− 1	2*	...	...
Colombo, Ceylon	1009·4	− 2·1	89	65	84·8	70·2	77·5	− 1·6	73·5	73	4·9	90	+ 1	12	7·0	59
Hong Kong	1017·8	− 2·0	75	41	61·1	53·3	57·2	− 3·0	52·6	77	8·3	110	+ 75	12	2·9	27
Sandakan	...	...	88	72	85·4	74·4	79·9	0·0	75·5	84	...	682	+213	17	...	...
Sydney	1013·1	+ 0·6	98	53	75·5	63·4	69·5	− 2·1	65·2	70	7·8	120	+ 27	15	5·3	38
Melbourne	1013·3	+ 0·4	97	47	76·7	56·1	66·4	− 1·1	59·2	61	5·4	81	+ 34	9	8·4	58
Adelaide	1013·2	+ 0·2	96	52	83·6	61·3	72·5	− 1·6	60·0	43	4·7	10	− 8	4	9·9	70
Perth, W. Australia	1011·8	− 0·7	95	49	83·3	61·4	72·3	− 1·6	61·6	50	3·0	17	+ 9	4	10·5	76
Coolgardie	1011·1	− 0·3	103	48	85·9	60·3	73·1	− 4·3	58·5	46	4·7	11	− 1	4	...	...
Brisbane	1011·8	+ 0·4	95	62	81·7	67·0	74·3	− 2·9	69·2	70	7·1	190	+ 27	18	5·1	38
Hobart, Tasmania	1013·5	+ 3·2	87	42	68·8	51·7	60·3	− 2·0	54·5	63	6·7	51	+ 6	13	6·8	46
Wellington, N.Z.	1016·2	+ 3·4	78	46	70·2	56·5	63·3	+ 0·9	58·6	68	6·2	95	+ 11	9	7·3	50
Suva, Fiji	1007·9	+ 0·2	90	69	87·7	71·7	79·7	− 0·2	75·6	77	5·9	360	+ 88	23	...	...
Apia, Samoa	1007·8	− 0·1	88	73	84·7	74·6	79·7	+ 0·7	76·7	74	7·0	311	−116	19	4·6	36
Kingston, Jamaica	1015·8	+ 0·7	89	62	85·4	66·3	75·9	− 0·9	64·4	84	2·0	9	− 15	3	...	...
Grenada, W.I.	1015·4	+ 2·6	83	67	80·6	70·4	75·5	− 1·5	71·0	75	4·0	103	− 10	23	...	...
Toronto	1021·9	+ 4·5	40	−11	28·3	12·4	20·3	− 1·8	16·6	64	7·7	51	− 22	17	2·4	26
Winnipeg	1020·3	+ 0·5	34	−26	8·0	−7·1	0·5	+ 4·9	...	...	5·0	41	+ 22	12	2·8	33
St. John, N.B.	1019·4	+ 3·7	41	−19	19·4	3·5	11·5	− 7·7	7·7	...	4·7	120	− 2	13	4·6	51
Victoria, B.C.	1015·7	+ 0·4	50	31	44·1	37·6	40·9	+ 0·8	38·9	92	8·7	127	+ 12	25	2·0	23

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

Reference Table.—Climatological Table for the British Empire.

STATIONS.	Lat.	Long.	Height above M.S.L.	Hour of Observation.*	AUTHORITY.	Period of Normals. Pressure.	Temp.	Rainfall.
			Ft.					
London, Kew Obsy	51°28′N	0°19′W	34	7	Meteorological Office, Air Ministry, London	'81-'15	'81-'15	'81-'15
Gibraltar	36° 6′N	5°21′W	53	7	Colonial Secretary, Gibltr.	'52-'20	'52-'20	'52-'20
Malta	35°53′N	14°30′E	185	7	Meteorological Office, Air Ministry, London	'52-'23	'53-'23	'53-'23
Sierra Leone	8°29′N	13° 9′W	224	9	Medical and Sanitary Department, Freetown	'91-'20	'75-'20	'47-'51 '75-'20
Lagos, Nigeria	6°27′N	3°24′E	13	9	Surveyor-General, Lagos	'91-'15	'86-'00 '06-'15	'86-'19
Kaduna, Nigeria	10°32′N	7°25′E	2,088	9	Surveyor-General, Lagos	('91-'20)	('07-'23)	('14-'24)
Zomba, Nyasaland	15°23′S	35°18′E	3,270	9	Director of Agriculture	'99-'20	'92-'20	'92-'20
Salisbury, Rhodesia	17°48′S	31° 5′E	4,860	9	Hydrographic Engineer	'97-'23	'98-'03 '07-'20	'97-'20
Cape Town	33°56′S	18°29′E	40	8½	H.M. Astronomer	'84-'20	'84-'20	'84-'20
Johannesburg	26°11′S	28° 4′E	5,925	8½	Chief Meteorologist, Pretoria	'04-'20	'04-'19	'88-'13
Mauritius	20° 6′S	57°33′E	181	9	Royal Alfred Observatory	'61-'19	'61-'19	'61-'19
Bloemfontein	29° 7′S	26°13′E	4,696	8½	G. H. Schepers, Esq., Grey College	'70-'84	'81-'99 '03-'06	'78-'99 '03-'13
Calcutta, Alipore Observatory	22°36′N	88°23′E	21	8	Director-General of Observatories, Simla	'89-'10	'78-'10	43 yrs.
Bombay	18°54′N	72°49′E	37	8	Do. do.	'47-'16	'75-'16	'47-'16
Madras	13° 4′N	80°14′E	22	8	Do. do.	'89-'20	43 yrs.	43 yrs.
Colombo, Ceylon	6°54′N	79°53′E	24	9½	Surveyor-General, Colombo	'12-'24	'08-'24	'08-'24
Hong Kong	22°18′N	114°10′E	109	9	Director, Royal Obsy.	'84-'18	'84-'18	'84-'18
Sandakan	5°50′N	118° 7′E	—	9	Principal Medical Officer	—	'79-'95 '05-'20	'79-'95 '05-'20
Sydney	33°52′S	151°13′E	138	9	Commonwealth Meteorologist, Melbourne	'59-'22	'59-'22	'59-'22
Melbourne	37°49′S	144°58′E	115	9	Do. do.	'58-'19	'56-'19	'56-'19
Adelaide	34°56′S	138°35′E	140	9	Do. do.	'57-'18	'57-'18	'39-'19
Perth, W. Australia	31°57′S	115°51′E	197	9	Do. do.	'85-'21	'97-'21	'76-'21
Coolgardie	30°57′S	121°10′E	1,389	9	Do. do.	'97-'19	'97-'19	'93-'19
Brisbane	27°28′S	153° 2′E	125	9	Do. do.	'87-'22	'87-'22	'52-'22
Hobart, Tasmania	42°53′S	147°20′E	177	9	Do. do.	'85-'19	'71-'19	'41-'79 '82-'19
Wellington, N.Z.	41°16′S	174°46′E	10	9	Meteorological Office, Wellington	'65-'17	56 yrs.	59 yrs.
Suva, Fiji	18° 8′S	178°26′E	20	9	Superintendent, Department of Agriculture	'86-'16	'86-'18	'86-'18
Apia, Samoa	13°48′S	171°46′W	7	9	The Director, Apia Obsy.	'90-'23	'90-'23	('90-'23)
Kingston, Jamaica	17°58′N	76°48′W	111	7	Government Meteorologist	'81-'98 '08-'22	'80-'99 '07-'18	'70 '72-'18
Grenada, W.I.	12° 5′N	61°46′W	509	9	Superintendent of Prisons, Richmond Hill	('76-'15)	'87 '91-'18	'87 '91-'18
Toronto	43°40′N	79°24′W	379	8	Director, Meteorological Service of Canada	'00-'18	78 yrs.	70 yrs.
Winnipeg	49°53′N	97° 7′W	760	7	Do. do.	'00-'18	45 yrs.	'75-'14
St. John, N.B.	45°17′N	66° 4′W	119	9	Do. do.	'02-'18	45 yrs.	'61-'10
Victoria, B.C.	48°24′N	123°19′W	230	5	Do. do.	'00-'18	29 yrs.	'81-'10

* Local or zone time.

NOTES :—

From January, 1925, the mean wet bulb, relative humidity and mean cloud amount refer to the morning hour of observation only. The pressure is reduced to mean of day as hitherto.

Salisbury, Rhodesia. The data refer to Department of Agriculture (4,860 ft.) from January, 1924. Diffs. from normal pressure refer to the Gaol station (4,825 ft.) until September, 1924, and then to the Department of Agriculture.

Hong Kong. Observations refer to 9h, 120th meridian time for January to April, 1925, and to 9h, local time from May, 1925, onwards.

Apia, Samoa. First included in June, 1924.

Continued from p. 151.

London. Heavy rain and thunderstorms occurred locally in southern France on the 9th, and thunderstorms caused much damage to the crops in Switzerland on the 13th to 15th. Towards the end of the month the drought in central Europe ended and heavy rain fell. This was followed by a drop in temperature. A landslide occurred on the bank of the Rhine near St. Goar, and fifteen villages were flooded by the overflowing of the Dniester in Poland. Snow occurred on the Alps down to the 5,400 ft. level, and in the Abruzzi four villages were almost destroyed owing to the heavy rains there. In Sweden pressure was below normal, and rainfall (except in the central districts) above normal. Heavy thundershowers occured locally on the 20th to 27th.

The northern part of the coast of Labrador was still blocked with ice by the middle of the month, making fishery operations difficult. A heat wave lasting about 4 days passed across the middle and eastern districts of the United States and across eastern Canada in the early part of the month. Temperatures of 100° F. were registered in several places on the 5th and 6th, e.g., Philadelphia, Baltimore. In Canada 98° F. occurred at London (Ontario). Though these heat records do not exceed those often reached in midsummer they are exceptional for June. During the same period keen frosts occurred in Idaho. At Yuma (Arizona) a maximum temperature of 112° F. was recorded on the 21st. Many people were drowned and several hamlets destroyed in the Isthmus of Tehuantepec (Mexico) through the overflowing of the Tehuantepec and Perros Rivers.

The chief crops in Angola, W. Africa, have suffered considerably owing to drought. During the last days of the month a severe gale was experienced on Lake Victoria.

Heavy rains and high winds in Malabar are causing anxiety lest the disastrous floods of last year should be repeated.

The rainfall in Australia was below normal, except in New South Wales and the Queensland coastal districts where floods occurred. Flood waters on the Murrumbidgee reached Hay by the 12th.

The special message from Brazil states that the rainfall was scanty over the whole country being 13 mm., 62 mm. and 44 mm. below normal in the northern, central and southern districts respectively. Fewer anticyclones passed across the country than in the previous month but the weather was unusually cold in the central and southern regions. The condition of the crops was generally good though the lack of rain was affecting some of them. Pressure at Rio de Janeiro was 1mb. above normal and temperature 0·9° F. below normal.

Rainfall June, 1925—General Distribution

England and Wales ..	6	per cent. of the average 1881-1915.
Scotland	39	
Ireland	23	
British Isles	18	

M.O. 278.

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The King's Cup Air Race

Meteorological Conditions

THE air race round Great Britain for the cup presented by H.M. the King was flown in two circuits of 804 miles a day. The flights on the first day, Friday, July 3rd, were carried out under conditions of weather which, while testing to the utmost the skill of the competitors, only served to enhance the brilliance of the performances of the four pilots who succeeded in completing the circuit.

During the week previous to the race, the predominating feature of the weather charts was an anticyclone which moved slowly across England to Scandinavia. On Thursday a depression spread eastwards over northern France resulting in an easterly wind current over the British Isles. On Friday morning the south-east of England, under the influence of the depression over northern France, was overcast with low clouds from which slight rain fell intermittently. North of London conditions were even worse. Stations on the east and north-east coasts reported fog, while further inland there were banks of very low cloud which enveloped most of the eastern half of England. Both these phenomena could be traced to the same cause; an influx of warm air drifting across the North Sea from the Continent. Under these conditions the fog on the coast is readily explained but it is a little remarkable that it extended so far inland where it appeared as low cloud owing, doubtless, to the greater turbulence at the surface of the ground.

Wt 69—P 1 1000 8/25 M & C

In spite of the adverse weather reports the first machines left Croydon at the scheduled time, 6 a.m. During the morning it became known that no fewer than seven of the competitors had been forced to land near the eastern flank of the Chilterns owing to low cloud. One pilot, Major Bulman, had a narrow escape in landing through the fog at Bedford. An idea of the weather conditions between Croydon and Newcastle can be obtained from the following account by Captain F. Tymms, who accompanied Major Hemming as navigator on a D.H.37 machine.

"Just north of Watford visibility decreased to about 100 yards and the cloud base was found to touch the ground. We therefore climbed through the cloud, emerging from the bottom layer at about 2,000 feet. Another layer of cloud, mainly alto-stratus and alto-cumulus, was found above us. After climbing to 8,000 feet, the height of this upper layer was estimated to be between 10,000 and 12,000 feet. Between the two layers haze, which thickened as we flew northwards, prevented the formation of a clear horizon, thus increasing the pilot's difficulty in keeping the machine on a steady course and an even keel. Shortly after 9 o'clock, when we were north-west of Leicester, the upper layer of clouds cleared and the haze disappeared. At 9.18 some distance to the westward, we found a hole a few miles across, and seeing that the top layer of clouds and the haze recommenced to the northward, we decided to go down in order to verify our position and to see whether it was possible to fly underneath the bottom layer. We shortly afterwards ran into light rain, and while steering north-east to get back to the low country over Lincolnshire we were forced down by the low cloud into a valley and landed north of Derby at 9.40.

"It was 12 o'clock before the clouds lifted sufficiently to enable us to continue, and after getting off we found that they were still only 100 feet above the hill-tops and in some places lower. The visibility nowhere exceeded 500 yards. These conditions were experienced all the way to Harrogate. On leaving Harrogate at 1.30 we found a remarkable change. The clouds were still low (about 300 feet) but, flying beneath them, visibility was at least 20 miles. When passing Ripon the north-west shoulder of the Cleveland Hills could be seen plainly. West of Darlington visibility dropped to 200 yards and the cloud base descended. In order to pass the high ground between Darlington and Durham we had to follow the railway which passes through a gap at Ferry hill. At that time the visibility was only 100 yards. Over the lower country between Durham and Newcastle visibility improved owing the the greater height of the cloud base above the ground." It is worthy of note that both Major Hemming and Captain Tymms have expressed the opinion that,

had their machine been fitted with a twin indicator, they would have been able to continue their course above the lower cloud layer till they were east of Harrogate, and in view of the conditions actually prevailing at Harrogate at the time they would then have been able to land at the aerodrome, thus completing the first stage of the flight without having made a forced landing.

The unpleasant conditions of low cloud and poor visibility extended further west over the Cheviots, but in the west of Scotland the cloud layer was broken and visibility improved. From Renfrew to Sealand, conditions were rather better, visibility being as much as 10 miles in places. Haze, however, occurred locally. Over southern England low cloud persisted throughout the day apart from a partial temporary lifting in places during the afternoon. Thunderstorms were experienced by the competitors along the last stage of the flight between Bristol and Croydon. Captain Tymms stated that they encountered a thunderstorm over the Marlborough Downs with heavy rain and clouds on the tops of the hills. A second thunderstorm was encountered east of Newbury, and during this period the light failed to such an extent that it was scarcely possible to see the compass or maps.

Captain F. L. Barnard, flying a Siskin V, was the first pilot to reach Croydon. Great credit is due not only to him but to the pilots of the other three machines who completed the circuit under conditions which, from the point of view of aviation, could hardly have been worse.

On Saturday, July 4th, when the same course was followed, but in the opposite direction, there was a general all-round improvement in the weather, no phases of it calling for special comment. Of the four pilots who completed the circuit the previous day, three started on Saturday, Mr. Hinkler having withdrawn from the race. The first home and winner of the race was Captain F. L. Barnard, Squadron Leader Jones and Major Hemming following. The overall average speed of the winning machine was 130 m.p.h. on the first day and 151 m.p.h. on the second. The fact that such speeds were maintained over a difficult course and with extremely adverse weather conditions speaks very highly for the skill and courage of the pilots and the excellence of the work of the aircraft industry. It is striking proof of the great advance made in aviation in this country in recent years.

A special race was organised on Saturday over a shorter course for those competitors who were unfortunate enough to have to withdraw from the main race owing to the adverse weather of the previous day. The "Croydon Stakes," as this race was named, was won by Colonel the Master of Sempill.

F.E.

Amundsen's Polar Flight

MANY proposals have been made for a flight to the North Pole and a possible survey of the polar regions from airships or aeroplanes, but the first real attempt in this direction was made this summer by Captain R. Amundsen.

From a meteorological standpoint the flight possessed considerable interest owing to the small amount of reliable information in existence regarding weather conditions in the regions farthest north. For a number of years weather observations have been made at the Norwegian radio station in Green Harbour, Isafjord, on the west side of Spitsbergen, while information also exists regarding weather conditions over Jan Mayen and Bear Island. There are in addition a few stations on the Russian and Siberian Arctic coasts and also at Nome and Pt. Barrow, Alaska. A series of different expeditions has given information regarding the weather on some of the other Arctic Islands but the far north is largely unexplored country from a meteorological point of view. The Fram expedition (1894-6) was the only one to draw up complete data for the Arctic Ocean.

In considering the different meteorological elements which may affect flying in these regions the data obtained from Spitsbergen, the starting point for this flight, indicated that May was the most suitable month for the flight. The wind at all times of the year has a low mean speed with a marked seasonal change from south-east or south in summer to north or north-west in winter. Gales are exceptional, while cloud amounts are generally less in winter and early spring than in other parts of the year. The lowest monthly total of rainfall and the smallest number of days of precipitation occur in May or June. The factor most troublesome for aviation in the polar regions, however, is the prevalence of low-lying banks of fog in the summer. For all practical purposes fogs are absent from the end of September until the beginning of May but there is a steadily increasing frequency from the beginning of May until the middle of July. The Fram expedition obtained a value as high as 36 % for days of fog in the Arctic Ocean for mid-July.

For Amundsen's flight two Dornier Wal flying boats (each fitted with two Rolls Royce Eagle engines) were used and each machine carried a pilot, a navigator and a mechanic. At the time of departure from King's Bay, Spitsbergen, an anticyclone was spreading northwards from Iceland and had just extended its influence over Spitsbergen. At 5 p.m. on May 21st, when the flight commenced, very favourable weather conditions prevailed—a calm, exceptional visibility, and a sky only three-tenths covered with cloud, the base of which was above 2,000 feet. Fog was encountered at Sydgat and the machines flew above this for two hours, eventually leaving it behind an hour

later. Both machines landed about latitude 88°N. in order to obtain accurate bearings, but the ice conditions were such that they were unable to proceed farther north, and over three weeks were spent here before any further progress could be made. Little change occurred in the pressure distribution for the first few days after the machines had left, but at Spitsbergen itself within two days the weather deteriorated and occasional rain, sleet or snow was encountered. Little news is at present available of the weather conditions experienced by the exploration party after the landing. The return was made on June 15th with all the members on one machine. Fog was again encountered but Spitsbergen was reached in safety.

To give the expedition a better chance of making the flight under the best conditions it is understood that additional observations were obtained from the meteorological stations in high latitudes and that Dr. J. Bjerknes was in Spitsbergen to advise regarding the weather conditions. While one cannot but admire the personal courage involved in such an undertaking as this, one must confess that very little information of meteorological value can be obtained from an isolated flight. In such a case it is difficult to decide if the weather phenomena which may be encountered are normal to the district or of an exceptional nature.

Captain R. Amundsen on his return has expressed himself against the possibility of a successful polar expedition by aeroplane owing to the exceptionally difficult conditions for landing on and taking off from the ice fields. While one must respect this view, there is the incentive that one flight which was not quite successful has a tendency to lead to others which ultimately attain their objective and perhaps to a regular service of aircraft, heavier or lighter than air. Before such a service can eventuate, however, much more meteorological information regarding the polar regions will be required.

R.S.R.

OFFICIAL PUBLICATION

The following publication has recently been issued :—

Advisory Committee on Atmospheric Pollution. Tenth Annual Report ; for the year ending March 31st, 1924.

The Committee for the Investigation of Atmospheric Pollution was appointed by a conference of delegates of municipal authorities and others held in connection with the Smoke Abatement Exhibition in 1912. With the issue of the present Report, which covers the year ending March 31st, 1924, the Committee thus completed the twelfth year of its activity. The primary objects

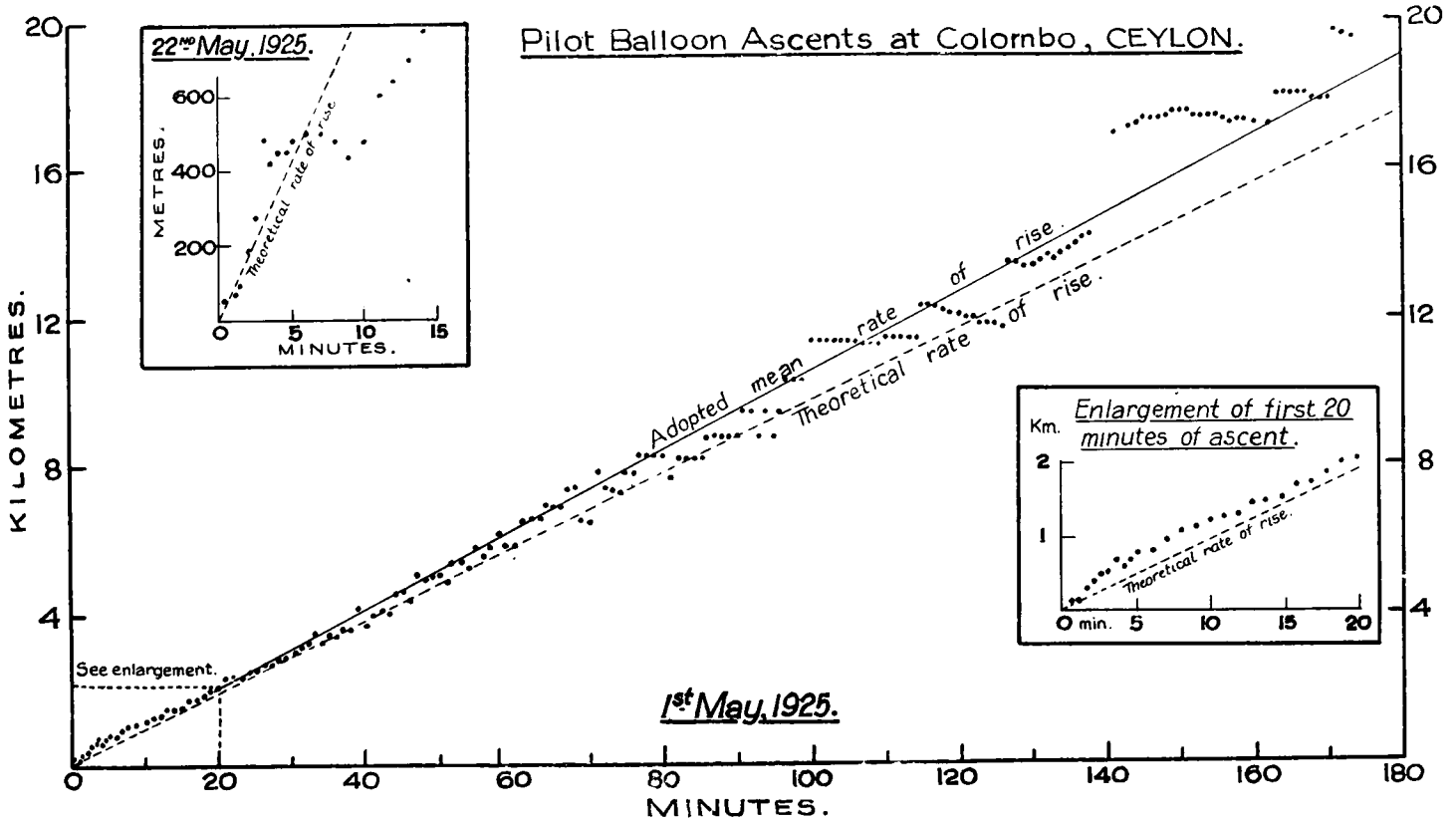
of the Committee are the systematic measurement and analysis of atmospheric impurity and the collection of a body of suitable data for the solution of various problems affecting the purity of the air in which we live and, in consequence, the health of the community.

Following a short Introduction and Summary of the year's operations, the Report is divided into eight sections. Three of these sections deal with the results obtained by what is known as the Standard Deposit Gauge, the primary function of which is to collect deposited impurity so as to compare the measurements of the amounts which fall in different localities, the Automatic Filter which measures hourly the amount of impurity suspended in the air, and the Jet Dust Counter which allows a microscopic examination of dust particles and their number to be made. The remaining sections deal with aspects of the work which are in an experimental stage as well as observations which are of especial interest in connection with the study of atmospheric pollution. In the former class may be mentioned the researches on the visibility of distant objects as affected by atmospheric pollution, and spectographic analysis of suspended impurities, in the latter class, the discussion of the darkness of Wednesday, January 23rd, 1924, and of the distribution of dust in the vertical based on observations by Dr. Kimball of the United States Weather Bureau.

We learn from the Report that the air was not as pure as in the previous year. At Blackburn and Stoke-on-Trent the diurnal distribution of atmospheric pollution is broadly similar to that found in other cities with a maximum in the forenoon. An important peculiarity of the Blackburn curves is the rapid rise of impurity which commences about 4 a.m. in the summer and reaches its maximum on week-days and Saturdays at 7 a.m., while on Sundays the maximum is not reached until 10 a.m.

A description is given of a new instrument, the Settlement Dust Counter, designed by Dr. Owens, for measuring the amount of dust particles or bacteria in the air even when such dust particles are very coarse as in grain warehouses and similar places.

About 19h. 40m. towards the end of a thunderstorm on July 27th, Mr. H. J. E. Dobson observed at Norwood a vivid white globe of about 18 in. diameter (flattened at the top) which appeared to be moving rapidly towards an earthed aerial wire. The globe was about 18 ft. above the ground and burst about 1 second after its first appearance. The explosion was preceded by a sizzling noise and according to another observer was accompanied by a violet tinged flash.


Pilot Balloon Ascents at Colombo, CEYLON.
22nd May, 1925.
METRES.
600
400
200
Theoretical rate of rise.
0
5
10
15
MINUTES.
Adopted mean rate of rise.
Theoretical rate of rise.
Enlargement of first 20 minutes of ascent.
Km.
2
1
Theoretical rate of rise.
0 min.
5
10
15
20
See enlargement.
1st May, 1925.
KILOMETRES.
20
16
12
8
4
0
20
40
60
80
100
120
140
160
180
MINUTES.

to face p. 163

Correspondence

To the Editor, *The Meteorological Magazine*

Pilot Balloon Ascents at Colombo, Ceylon

Two recent flights at Colombo may be of interest, as illustrating the value of tail observations with one-theodolite flights.

The first shows that these observations may be of considerable value, even at very high altitudes. A balloon, released at 14h. 44m. on May 1st, 1925, was observed by Mr. H. T. de Silva, for 173 minutes, the estimated final height being over 18 km. The balloon was finally lost behind low cloud, while still visible without great difficulty. This is the longest and highest flight yet observed at Colombo.

The length of a 20 metre tail (with a pendant at 5 metres, for use at the commencement of the flight) was estimated at each minute, and, for the first five minutes, at each half-minute, by comparison with a graticule of spider webs at the focus of the eye-piece. The height was computed graphically for each tail observation, and these heights were plotted as ordinates against the time. In this case the computed heights were adopted up to the 20th minute, except that those at $3\frac{1}{2}$, 6, 12, 16, 19 minutes were smoothed, while from the 20th minute to the end of the flight a mean rate of 106 m/min. was deduced from the tail observations, the theoretical rate, on the formula, $V=81\ L^{\frac{1}{2}}/(W+L)^{\frac{1}{2}}$, being 97. This is shown by a dotted line on the graph.

While an error in the grid, or personal equation in estimating, might cause fairly large errors in the absolute rate of rise deduced from these observations, yet the graph leaves no doubt that the balloon was rising fairly uniformly throughout. Without it, one might not have been sure that the balloon was not descending in the latter part of the flight, and could certainly not have affirmed that the rate of rise had not altered so much as to invalidate the velocities deduced.

In this connection it may be worth mentioning that there has been noted here a general tendency for the rate of rise of the balloons, measured in this way, to increase after a height of some six kilometres or so is reached. This increase is not particularly noticeable on the graph for May 1st, but in many cases is quite well marked. A possible explanation is that it is due to a tendency to underestimate apparent tail-lengths, when these are only a fraction of one interval of the comparison grid. It has been noticed with four separate observers, of different ages and races (Messrs. Bamford, Dassanayake, De Silva, and myself) so can hardly be explained as a personal equation, but might be due to a general tendency to underestimate in such observations. The point may perhaps be settled by a statistical investigation as to whether the change tends to set in at a

definite altitude, or at a definite apparent tail-length, and this investigation has now been started.

Should the psychological explanation prove insufficient, the phenomenon may be due either to actual convection effects in the upper air over Colombo or to a tendency for the balloons to rise faster at greater altitudes, owing to the diminishing air resistance more than counterbalancing the loss of pull from leakage. The facts that the change of rate is, in spite of the inaccuracy of individual observations, frequently noticeably abrupt, and that no consistent increase in rate has been noticed below 6 kilometres, are arguments against the latter view.

The second flight, a low one, on May 22nd, apparently indicates a rolling type of turbulence in the lowest layers. The theoretical rate of rise is shown as a dotted line. The observed heights were taken without smoothing, except at the 3rd and 11th minutes. H. JAMESON.

Colombo Observatory, Ceylon. May 28th, 1925.

[We welcome this letter which shows that upper air investigation is being vigorously pursued in Ceylon. To follow a pilot balloon for nearly three hours is no mean achievement. The diagrams require some comment. The horizontal rows of dots in the upper part of the ascent of May 1st suggest that the tail measurements were not sufficiently exact. For example, if everything between 7·4 and 6·5 were called 7, while 6·4 became 6, the balloon would apparently float nearly at one level for some minutes and then jump suddenly to a higher level. Some of the irregularities are possibly due to a slow swinging of the tail, and this may be the explanation of the "rolling" effect found with the ascent of May 22nd. Ed. *M.M.*]

The June Drought at Guernsey

JUNE was rainless at Guernsey. It is the first rainless month noted here since observations were begun by the late Dr. S. E. Hoskins, M.D., F.R.S., in 1843. The drought which lasted for 33 days, from May 30th to July 1st, is not, however, quite the longest on record here. In 1893, the spring and early summer of which was exceedingly dry, no rain was measured for 35 consecutive days. This drought began on March 18th, ended on April 21st, and was followed by another which, beginning on May 21st lasted for 33 days and came to an end on June 22nd.

I commenced observing in 1894, and in 1899 I registered a drought of 34 days duration (July 24th to August 26th). Although this year's drought was beaten for length in 1893 and again in 1899 the interesting fact is the occurrence of an absolutely dry month—the only one registered in 82½ years of observation. BASIL T. ROWSWELL.

Les Blanches, St. Martin's, Guernsey. July 11th, 1925.

Sea Fog over Land

IN reply to Mr. Whipple's note on "Sea Fog over Land," in the June issue of the *Meteorological Magazine*, I would like to say that I have noted the same phenomena—cloudy patches forming over bare soil or ploughed land, while the grass land adjoining remained comparatively clear—several times and that the sun need not reach the zenith for these conditions to occur, as they have been noted as early as 9 a.m.

This steaming effect, as viewed from a prominence, was particularly marked on the morning of December 16th last at Larkhill. The soil on this occasion was quite damp, and can certainly be classed as light. The wind was about 4 m.p.h. from the south-west. It is a coincidence that the pressure distribution over the south of England on this date should be very similar to that of April 11th, when Mr. Whipple's observations were made.

P. RAYMOND ZEALLEY.

Larkhill, Salisbury Plain. June 22nd, 1925.

The "Spectre of the Brocken" in Lakeland

ON June 28th an ascent of Sca Fell had been made by a small party, unable to leave Keswick before a quarter to one (summer time) by cycle and motor-cycle for Seathwaite. Hence evening had well advanced as we neared Esk Hause (2,500 ft.) on the return. The others, hastening for a dip in Sprinkling Tarn, were five or ten minutes ahead and missed what follows:

Light clouds had been troublesome about the summits, but these were now beautifully clear. Instead clouds were forming on the upper valley slopes. Those in Eskdale, which drops towards south-west by south were drifting up over the Hause in fleecy tenuous streams, dissolving as a rule in falling to the pass from Sty Tarn to Angle Tarn, lying at right angles, 200 ft. below. The sun was then (8.50 p.m. summer time) still very bright, though low in the west north-west between Sca Fell Pikes and Great End.

The descent approaches Esk Hause from the west, turning then sharp north, the slope dipping gently towards the Hause. The thought struck me that the conditions for seeing the "spectre" were ideal. Told about it first in early boyhood, I never actually witnessed it. Looking, therefore, to the right on reaching the spot my expectations were amply justified. The shadow of my legs stretched along the slope to the cloud stream some 200 yards away, upon which that of my body, stick and head was seen upright. The last was the centre of a brilliant "glory" in all 7° to 10° across, as roughly estimated afterwards by comparison with the moon. Next the head came a bright circle, white with a faint ruddy tint, some 4° across and enclosed in a dark blue ring nearly ½° wide. Another light

ring, but yellowish, 1° to 1½° wide, separated this from a red ring, ¾° wide. Beyond it at times and slightly separated from the red, were right and left arcs of a second blue ring. The inner circle and blue ring were complete. Arcs of the others rested on the ground like those of a rainbow. The "spectre" itself mocked my movements in orthodox fashion. The whole waxed and waned as the density of the fleecy clouds increased or decreased. It still persisted, accompanying me awhile down the slope, when at nine I had perforce to continue my descent. I wished I retained sufficient knowledge of optics to understand precisely how the phenomenon is formed.

J. EDMUND CLARK.

41, *Downscourt Road, Purley, Surrey. July 1st*, 1925.

[An explanation of how the Brocken Spectre is formed, is to be found in the Dictionary of Applied Physics, Vol. III., p. 527, § (15). It was so named from having been first observed in 1780 on the Brocken, Germany. Ed. *M.M.*]

An Unusual Lunar Eclipse

AT 11 p.m. on February 20th, 1924, there was an eclipse of the moon, which was witnessed at Kroh in Upper Perak (Malay Peninsula). At the time the British Squadron was cruising, and I hoped that there would be a report, but the incident seems never to have been noticed. I give now the account as I wrote it down in my journal at the time and I should be very glad to have an explanation of the phenomenon, if possible.

"20th Feb. 1924. This evening we witnessed a most extraordinary eclipse of the moon. It began normally, with a well-defined shadow, but half an hour later at 10.45 p.m. a vague smoky shadow, irregular in shape, and with no defined border, filled in the centre of the moon's disc. The brighter edges of the moon round the shadow were angry orange, as if light were passing through a smoke or vapour. (It occurred to me at the time there might have been a volcanic outburst in Java, but this was not the case). At 11.30 p.m. a new and mysterious phase set in, most amazing to watch. Though the sky was completely fine, the full moon came and went, as if it were being crossed by scudding clouds. Often it was completely blotted out, not even a halo being visible, though the adjacent stars were shining as usual. The moon kept reappearing with varying brightness, only to disappear again into complete darkness for as much as half a minute at a time."

My regiment was in camp at the time. The phenomenon was witnessed by several other officers. Two said they had noticed an unusually fine sunset, though I had not done so.

C. M. ENRIQUEZ.

Taiping, Federated Malay States. May 3rd, 1925.

[The total phase of this eclipse in Perak lasted from approximately 10h. 20m. to 11h. 57m. (Zone Time) and the moon's altitude was high, about 85° at the end of totality. The observation of a central dusky area encompassed by a more luminous orange ring is quite usual during an eclipse and arises from the grouping of the maria on the moon's surface. The brilliancy of the eclipsed moon depends upon the quantity of light refracted through a ring of the earth's atmosphere lying round the great circle where, at the moment under consideration, the sun is on the horizon. The moon is invisible in some eclipses and relatively bright in others, but usually it is quite a conspicuous object. These differences have been explained as due to variations in the amount of refracted light, owing to different conditions of cloudiness, amount of aqueous vapour present, etc., but the subject has apparently never been quantitatively treated. Major Enriquez's observation of the rapid variation of brilliancy during the course of an eclipse is very interesting. On one occasion (October 13th, 1837) Sir John Herschel saw "various and changeable distributions of light" and one or two other observers have noted varying colours during the progress of an eclipse, but a definite observation of rapid changes does not appear to have been previously put on record.—ED. *M.M.*].

Thunder Coming Up Against the Wind

ABOUT 9 p.m. on the evening of July 22nd, after a violent thunderstorm had passed over this district, I encountered a striking, and in the circumstances, useful illustration of the principle that a thunderstorm is frequently observed to come up against the surface wind. I was standing on the edge of Hampstead Heath undecided as to whether it would be safe to venture very far with nothing but the undesirable shelter of trees in the event of a renewal of the storm; for the sky, still overcast, gave no clue which I could recognise as to whether it would prove merely the leaden aftermath that so often follows a thunderstorm or whether it would speedily thicken and darken again with the advance of a fresh storm drifting over in the warm and humid south east current prevailing at the time. I had just made up my mind to take the risk when I became aware of a very decided surface wind moving from the north, that is to say from the direction of the retreating storm and against the general south-east drift in which the clouds were moving. This, I argued, pointed to the existence of another thunder system to the south, which was apparently drawing in this northerly surface breeze, and which would probably soon arrive from the south, even though there were not at the moment any other decided indications thereof. Within half an hour there

was a renewal of torrential rain and violent thunder and lightning.

L. C. W. BONACINA.

27, Tanza Road, Hampstead, N.W.3. July 24th, 1925.

NOTES AND QUERIES

The Thunderstorms and heavy Hail Showers over south-east England on July 22nd, 1925

EXCEPTIONALLY heavy falls of hail accompanied one of the series of violent thunderstorms that occurred on the afternoon and evening of July 22nd, and caused much damage, breaking innumerable windows and even penetrating slate roofs. The heaviest hail fell shortly after 17h. G.M.T., and lasted nearly 10 minutes, irregular lumps of ice slightly exceeding two inches in diameter falling in the region extending from Woolwich and East Ham eastwards to Dartford and northwards to Romford, *i.e.*, in a strip of country fully 8 to 12 miles across. The pieces of ice were evidently conglomerations of many separate hailstones. There was preliminary thunder and lightning, which ceased during the fall of hail.

Destructive winds occurred at Ashford (south-east Kent), and on both sides of the Thames Estuary (at Sittingbourne and Shoeburyness); also in Cambridgeshire and Huntingdonshire. The latter accompanied the passage of a thunderstorm between 19h. and 20h. Funnel-shaped tornado-like clouds were observed at Shoeburyness and also in Cambridge and Great Chesterford (12 miles south south-east of Cambridge).

The thunderstorms under discussion had been preceded by others a day earlier. During that time there was a depression over the Bay of Biscay and western France, which deepened on the 22nd, while moving north to the western part of the Channel. Surface winds were mainly easterly over eastern England, and at noon there was a rapid increase and veer of wind with height as the following figures show:

Height.	Cranwell 10h. G.M.T.		S. Farnborough 12h. G.M.T.		Lympne 11h. G.M.T.	
	Direction.	Speed.	Direction.	Speed.	Direction.	Speed.
(ft.)	(°)	(m.p.h.)	(°)	(m.p.h.)	(°)	(m.p.h.)
Surface.	45	9	130	8	125	6
1,000	60	9	110	11	115	17
4,000	130	37	105	30	155	35
6,000	130	44	155	39	160	61
10,000	—	—	155	50	160	55

These changes of wind with height would lead one to expect a big horizontal gradient of temperature in an east to west direction, such as the following figures show to have existed:

Height.	Duxford (Cambridge) 8h. G.M.T.	Utrecht 7h. G.M.T.
(ft.)	(°F.)	(°F.)
1,000	66	80
4,000	64	72
10,000	45	46
15,000	25	31

Violent squalls accompanied the thunderstorms at Shoeburyness 53 m.p.h. from WSW, and at Cambridge up to 45 m.p.h. from S, but, although sudden falls of temperature occurred, these were probably not of the " line-squall " type. The general drift of the storms was from south to north, with the upper wind current, but winds from nearly every direction appear to have occurred in the lower layers, and so many thunderstorms occurred, over so large an area, that very detailed information would be necessary to correlate the different phenomena just described.

At Hampstead Observatory 47 mm. of rain fell in the 24 hours ending on the morning of the 23rd, and at Barking 44 mm.

E. V. NEWNHAM.

On the evening of Wednesday, July 22nd, 1925, the Woolwich and Plumstead district was visited by a very severe thunderstorm, extensive damage being caused by a heavy downpour of hail. Shortly after 17h. G.M.T. lightning followed by very loud thunder overhead was the signal for the commencement of the storm. Rain and hail began to fall, the hailstones increasing in size till within five minutes several were as large as a man's fist and weighed over 8 ounces. These large pieces of hail consisted of a white opaque centre surrounded by jagged ice crystals. An interesting specimen which was shaped like an oyster shell consisted of a number of small hailstones cemented around the white opaque centre. A large number of skylights and windows facing south were broken, and in a few instances slated roofs were penetrated. The fall of hail lasted for 12 minutes and was followed by torrential rain until 17h. 30m. G.M.T., when the storm temporarily ceased. Thunder and lightning accompanied by heavy rain continued at intervals for several hours, but no more hail fell.

Drainage arrangements were quite inadequate to cope with the rainfall, some of the lower roads were flooded and the water reached a depth of 3 feet in one of the roads adjoining the Plumstead Marshes.

G. A. LIVETT.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1925.

Unit: one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays).

Averages for Readings

		April	May	June
Cloudless days:—				
Number of readings	n	9	8	17
Radiation from sky in zenith ...	πI	468	524	579
Total radiation from sky ...	J	503	564	617
Total radiation from horizontal black surface on earth ...	X	741	769	809
Net radiation from earth ...	X—J	238	205	192

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

Cloudless days:—				
Number of readings	n_0	3	1	4
Radiation from sky in zenith ...	πI_0	64	98	80
Total radiation from sky ...	J_0	73	101	69
Cloudy days:—				
Number of readings	n_1	1	2	3
Radiation from sky in zenith ...	πI_1	160	122	140
Total radiation from sky ...	J_1	114	116	139

Unit for I = gramme calorie per day per steradian per square centimetre.

Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

Meteorological Exhibit at the Highland and Agricultural Society's Show at Glasgow, July 14th to 17th, 1925

THE Meteorological Office Exhibit was housed in the pavilion of the Board of Agriculture for Scotland. Diagrams, instruments and publications were shown, but the feature which attracted most interest was the demonstration of weather forecasting. Weather charts were drawn each day and the local Daily Weather Reports ordinarily produced at, and circulated from Renfrew Aerodrome were prepared and duplicated at the pavilion, including copies for distribution in Glasgow. The process was closely watched by a large number of spectators. Duplicated charts were exhibited outside the pavilion and in

other parts of the Show. The assistance of Professor G. W. O. Howe of the Electrical Engineering Department of Glasgow University and of Mr. D. Roberts and Mr. Craigie of the Radio Communication Company, who rendered valuable services in connexion with the wireless arrangements for the reception of the synoptic reports, is gratefully acknowledged. The press generally made favourable comments on the meteorological exhibit.

Many of the Scottish farmers present expressed their appreciation of the quality and usefulness of the forecasts issued by the Meteorological Office through the British Broadcasting Company.

A Floating Weather Bureau

IN the *Meteorological Magazine* for May, 1923, an account was given under the above heading of the meteorological work carried out, since 1921, on board the French vessel *Jacques Cartier*, which sails between French and American ports, and is used as a training ship for cadets of the French Mercantile Marine. The meteorological work initiated by Mr. Bowie has now become a regular part of the course. During each voyage observations are collected by wireless from all ships in the neighbourhood and transmitted to land four times daily. Since November, 1924, by the use of a very short wave-length (115 m.) the meteorological messages have been transmitted direct to Paris throughout the whole voyage across the Atlantic, and actually at certain hours when the vessel was in the Pacific. The number of observations received and transmitted has steadily increased and during the last voyage averaged thirty or forty a day. These observations and those taken on board the *Jacques Cartier* itself are broadcasted to the whole of Europe in the synoptic message sent out from the Eiffel Tower. The staff do not limit themselves to receiving and transmitting the observations however, and synoptic charts are drawn twice a day from the observations received from ships and from the synoptic messages issued by Europe and America. Forecasts for the chief transatlantic routes are made from these maps and are broadcasted at stated hours for the information of the ships which have co-operated. In bad weather it is not uncommon for all other ships to fall silent when the *Jacques Cartier* transmits its forecasts. Research is not forgotten and the birth of depressions off Cape Hatteras (the "Hatteras" phenomenon) has been investigated and described in a paper communicated to the French Academy of Sciences.

The International Meteorological Committee at the meeting held in 1923, passed a resolution commending the scheme of

work and requesting ships of all nationalities to assist. The meteorological campaign of 1924-1925 ended in June; the work has been so successful and the forecasts have proved so useful to shipping that it may be hoped that the organization of a permanent floating Weather Bureau on an international basis may not be long delayed.

The Colombian Meterological Service

IN July, 1920, the Republic of Colombia organised a meteorological service, under the energetic direction of the Rev. Father S. Sarasola, S.J., well-known as the founder and Director of the Observatory of Monserrat at Cienfuegos, Cuba. The headquarters of the new service were at first in the old Observatorio Nacional, but the equipment was poor and the location unsatisfactory. The headquarters were accordingly removed to the Colegio Nacional de San Bartolemé, Bogota, and a complete equipment was ordered from Europe. The new observatory which is situated at a height of over 8,000 ft. was inaugurated on September 24th, 1922. The first publication* of the new organisation has recently been received and the programme of activities which it contains holds out good promise for the future of the meteorological work in Colombia. This volume clears the way for future work by collecting the scattered information for Colombia obtained in previous years; the observations at the new observatory are to be published in annual issues, that for 1923 being just completed. Bi-hourly values from 6h. to 20h. of pressure, temperature, vapour pressure, relative humidity and wind, are given, together with daily rainfall figures and detailed cloud observations four times a day. Monthly and annual summaries of the various elements complete this excellent volume.

International co-operation is readily undertaken; observations are being contributed to the Réseau Mondial, and the new observatory plays its part in the hurricane warning service organised by the United States. We wish all success to Father Sarasola in his new home.

Tetrahedral Pilot Balloon for High Ascents

IT should be possible on clear and cloudless days to follow a pilot balloon through the theodolite to great heights provided the balloon does not burst and is not lost in the distance. The latter cause may be easily minimised by giving the balloon a high free lift, but the objection against this practice is that the balloon is more likely to burst before attaining the desired

* Notas Geofisicas y Meteorologicas. No. 1 Noticia del nuevo observatorio, con algunos datos sobre la climatologia y el magnetismo de Colombia. By Simon Sarasola, S.J., Observatorio Nacional de San Bartolemé Bogota, 1924.

height. Hitherto the causes of bursting of balloons have remained obscure. The general impression amongst meteorologists is that bursting is due to abnormal distension of the balloon in the upper air. Owing to the reduction of external pressure, the rubber is stretched. The balloon, therefore, either suddenly bursts or develops one or more pin-holes and collapses.

It appears to the writer of this note that, hitherto, the effect of one of the most potent factors which determine the volume of the balloon at any stage of flight has been underestimated. This is the leakage of hydrogen through the balloon fabric. It has been pointed out by Mitchell and Graham that the diffusion of gases through rubber is an extremely complicated phenomenon. In actual flight the hydrogen leaks out of the pilot balloon and air leaks in. It should be noted, however, that the pressure gradient across the balloon fabric is continually disturbed owing to the wind, and pressure and temperature lapse in the free atmosphere. Owing to these reasons, the escape of hydrogen is probably six or seven times faster than the admission of air into the balloon.

A balloon having the ordinary free lift distends rapidly just at the beginning of the flight, but once it has survived this initial distension and attained a considerable height the net effect of all causes is probably a contraction instead of a distension. It appears, therefore, that the immediate causes of bursting at high levels should be sought in the tangential stresses due to shrinkage and other causes such as temperature lapse, direct solar radiation, resistance to upward motion, friction due to the rotational motion of the balloon and wind, especially when it is gusty.

When a balloon begins to contract, there is an excess of surface to be disposed of. This is probably automatically adjusted and the spherical shape of the balloon conserved if the inflation has not passed the safe limit and the tangential stresses are not too great for the fabric to bear. If, however, the stresses are of such magnitude that the spherical shape becomes untenable the balloon will burst. Observations of the lines of rupture in burst balloons indicate that just before the final collapse the spherical balloon probably passes through an intermediate stage in which it is an unstable tetrahedron or some analogous shape.

It is, therefore, suggested that balloons intended for high ascents should be made in the tetrahedral form. Before an ascent these balloons should be inflated with hydrogen to the spherical shape and given a high free lift consistent with the safe limit of inflation. In a balloon of this description any serious distortion under tangential stresses will tend to bring it back to its original shape before bursting, viz., the tetrahedron.

This intermediate stage, however, owing to the new process of manufacture, is stable and hence there will be better chances of the balloon surviving the ordeal than at present. Preliminary experiments in this direction may perhaps be carried out by reinforcing the ordinary balloon with rubber strips along the traces of a tetrahedron on a sphere. S. N. SEN.

Review

Correlation in Seasonal Variations of Weather, IX.—A further study of World-Weather. X.—Applications to seasonal forecasting in India. By Sir Gilbert T. Walker, C.S.I., F.R.S. Ind. Met. Mem., Vol. XXIV., 4to, $11\frac{3}{4} \times 9$. Part IX., pp. 275-332 and Part X., pp. 333-345. Calcutta, Superintendent Government Printing, 1924. Part IX., 4s. 9d. Part X., 9d.

IN 1923 Sir Gilbert Walker published a *Preliminary Study of World Weather** in which from a number of correlation coefficients between the pressure or rainfall in action centres in different parts of the world he drew certain conclusions as to the manner in which seasonal variations of weather are brought about. These researches have now been carried into greater detail, and in the first of the memoirs under consideration we are presented with a statistical basis for seasonal forecasting in nearly all parts of the world. The principle which guides the work is Hildebrandsson's well-known theory of " centres of action," according to which there are certain points—usually the centres of permanent areas of high or low pressure—which are the " strategic points of the world's weather " ; conditions at intermediate points are largely governed by these centres of action. The weather of the British Isles for example is largely governed by the intensity of the Icelandic low, the Azores high and, in winter, the central Siberian high. It has long been realised that there is some connection between the centres of action in different parts of the world, but until Sir Gilbert Walker began to publish his results, a measure of the connection was available in only a few instances.

The present memoir contains some four thousand correlation coefficients. Among so many, even if the data for different centres were entirely unrelated, chance agreements would produce a few large coefficients. Employing data for 20 years, the probable value of a random coefficient is 0·15, but of 17 random coefficients the probable value of the greatest is 0·46 ; thus one coefficient of this value among seventeen proves nothing. Everyone who attempts to deduce connections from large numbers of correlation coefficients would do well to study the

* Reviewed in *The Meteorological Magazine*, 59 (1924) 25.

opening remarks on this subject. Out of the 360 correlation coefficients between Iceland pressure and some other variable, only 19 are accepted as significant. It is satisfactory to notice, however, that the great majority of the significant coefficients occur according to plan, as laid down in part VIII.; this consistency " supports the view that seasonal forecasting is capable of wider application than at present." In many parts of the world the persistence of weather from one month to another is so great that quarterly forecasts would be of very great value, in other parts, such as the British Isles, the reversal of the pressure distribution from one month to another may be so complete that a unit of three months is too long, but even here quarterly forecasts would be useful as a base line on which fluctuations of shorter period could be superposed.

The second memoir (part X.) gives an example of the detailed application of the general results of part IX. to seasonal forecasting in India, and improved formulæ are deduced for calculating the monsoon rainfall in different districts, and the winter rain and snow of the north-west.

News in Brief

We regret to learn of the death on July 29th, at the age of 87, of Professor H. Hildebrand Hildebrandsson, late Director of the Meteorological Observatory at the University of Upsala.

We also regret to learn of the death of M. Calwagen of the Norwegian Meteorological Service, whose aeroplane crashed while he was making a flight for observation purposes at Kjeller near Oslo.

On Sunday, July 26th, at the meeting for gliders and light aeroplanes at Vauville (Manche), Captain Massaux (Belgium), flew in a Vivette glider for nearly 11 hours, thus beating the late M. Maneyrol's gliding record of 8 hrs. 15 min.

Staff News: Air Ministry Tennis Tournament, Ladies Doubles, winners Miss Geake and Miss Quennell; Ladies Singles, runner-up Miss Geake.

The Weather of July, 1925

At the beginning of the month the low pressure systems south of Iceland and over France broke through the ridge of high pressure spreading across England and brought to an end the drought which had lasted over 30 days in some south-western districts. A depression centred off the mouth of the Channel on the 2nd was associated with thunderstorms in several parts of England, and later, as it moved first east and then north, caused northerly winds and cooler, cloudy weather in the south-east counties.

Very little rain fell in the London area during the first half of the month except on the 6th-7th when a trough of low pressure approached from the Atlantic. After the 10th the anticyclone off Ireland began to spread across England and another spell of bright warm weather began. Temperature rose to about 80° F. in many instances and sunshine records exceeded 14 hours at some stations in the south-eastern counties. In the north and west, however, conditions were affected by depressions near Iceland which spread gradually southwards until by 17th a depression was centred over north-west Ireland, causing rain in many parts.

By the 21st the depression had moved southwards to the Bay of Biscay, temperatures rose again above 80° F. and thunderstorms of considerable intensity occurred in many parts. On the 22nd severe thunderstorms accompanied by heavy rain passed over the southern and midland districts in the early morning and again in the evening; 47 mm. (1·85 in.) were measured at Hampstead, and 50 mm. (1·97 in.) at Shennington Rectory, Oxfordshire. In the Woolwich and Plumstead districts of London extensive damage was done by hailstones.* The highest temperatures since the beginning of the year were recorded on this date, notably 86° F. at Kew Observatory and 91° F. at Lincoln.

The last week was marked by a cooler type of unsettled weather. Thunderstorms associated with heavy rain occurring locally. On the 25th 34 mm. (1·33 in.) fell in an hour at Llangynhafal in Denbighshire. A depression which passed across England from the Hebrides caused gales in the Channel on the 27th.

The rainfall during the first half of the month was well below the normal, except in some parts of Scotland and Ireland. The heavy falls during the latter part of the month have, however, brought the totals in most districts above the normal, some stations in south-east England recording more than twice the normal.

Pressure was above normal over most of the North Atlantic (including the Azores) and over Scandinavia, but the excess nowhere reached 5 mb. In the north of Scotland pressure was slightly above normal, but over the remainder of the British Isles, France and Switzerland, and also over Iceland, the Faroes and Spitsbergen, there was a deficit, exceeding 5 mb. at Isafjord. Temperature was above normal in Scandinavia and Spitsbergen, being 7° F. and 4° F. above normal in Lapland and Spitsbergen respectively. Rainfall was generally rather heavy and thunderstorms were numerous. Stormy weather prevailed in Italy during the first part of the month and a severe storm devastated

* See p. 169

the country near Messina, uprooting many trees and causing damage estimated at £30,000. On the 22nd there were violent thunderstorms in France; in Paris, nearly 10,000 telephones were put out of action and over the country considerable damage was done to crops by wind, rain and hail. About the same time heavy rain occurred in Bessarabia and Transylvania, and the crops, which had already suffered considerably from the drought, were in danger of being washed away. A violent thunderstorm, accompanied by very heavy rain and hail, broke over Amsterdam in the morning of the 28th. In Russia, while heavy rains were hampering the harvesting in the Ukraine and other districts, Kazan was suffering from intense heat. During the last 60 years, northern Sweden has never experienced so many thunderstorms in any one month as in this last July.

About the middle of the month intense heat prevailed in Canada and the United States. Temperatures of over 95° F. were reported from several parts of Canada, and 100° F. was exceeded in the Atlantic and Gulf States. In the west, still higher temperatures prevailed, 118° F. being recorded at Phœnix, Arizona, on the 16th. The heat wave broke up about the 20th and was followed in Canada by much-needed rain.

In the middle of the month, floods involving considerable loss of life were reported from Korea, the incessant rains causing the Rakuto River to burst its banks and inundate a large area. Thunderstorms accompanied by heavy rainfall occurred in Hong Kong, culminating with a fall of 254 mm. (10 in.) in 11 hours on the 17th. The heavy rains caused floods and landslides, and many lives were lost in the Chinese quarter of the City. Floods in the Khyber have carried away earthworks of the Pass railway.

The special message from Brazil states that the rainfall over the whole country was rather scanty, being 12 mm., 10 mm. and 41 mm. below normal in the northern, central and southern districts respectively. Anticyclones of greater intensity than in the previous few months passed across the country and a spell of unusually cold weather lasted during the greater part of the month in the central and southern districts. The tobacco, cotton and cane crops are suffering from the lack of rain but the wheat is doing well. At Rio de Janeiro the pressure was almost normal and the temperature 3·2° F. below normal.

Rainfall July, 1925—General Distribution

England and Wales ..	110	per cent. of the average 1881-1915.
Scotland	80	
Ireland	111	
British Isles	102	

Rainfall: July, 1925: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square.....	3·58	91	150	*War.*	Birminghm, Edgbaston	3·19	81	137
Sur .	Reigate, Hartswood...	3·71	94	177	*Leics*	Thornton Reservoir ..	2·41	61	97
Kent.	Tenterden, View Tower	4·62	117	221	,, .	Belvoir Castle.....	1·79	45	74
,, .	Folkestone, Boro. San.	2·52	64	...	*Rut .*	Ridlington.....	2·17	55	...
,, .	Broadstairs, St. Peter's	2·41	61	116	*Linc.*	Boston, Skirbeck	1·04	26	47
,, .	Sevenoaks, Speldhurst.	4·20	107	...	,, .	Lincoln, Sessions House	·69	17	31
Sus .	Patching Farm.....	4·62	117	192	,, .	Skegness, Estate Office.	...	..	...
,, .	Brighton, Old Steyne .	4·21	107	203	,, .	Louth, Westgate	·45	11	18
,, .	Tottingworth Park....	5·21	132	208	,, .	Brigg	·79	20	34
Hants	Ventnor, Roy. Nat. Hos.	2·99	76	148	*Notts.*	Worksop, Hodsock....	2·30	58	101
,, .	Fordingbridge, Oaklnds	3·15	80	157	*Derby*	Mickleover, Clyde Ho..	1·78	45	73
,, .	Ovington Rectory	4·01	102	155	,, .	Buxton, Devon. Hos...	2·23	57	57
,, .	Sherborne St. John Rec.	2·80	71	126	*Ches.*	Runcorn, Weston Pt...	2·30	58	84
Berks	Wellington College...	3·77	96	182	,, ..	Nantwich, Dorfold Hall	2·42	61	...
,, .	Newbury, Greenham..	3·00	76	135	*Lancs*	Manchester, Whit. Pk.	1·98	50	60
Herts.	Bennington House....	3·52	89	...	,, ..	Stonyhurst College....	2·52	64	65
Bucks	High Wycombe	5·27	134	268	,, ..	Southport, Hesketh...	2·41	61	84
Oxf..	Oxford, Mag. College..	3·33	85	147	,, ..	Lancaster, Strathspey.	2·54	65	...
Nor .	Pitsford, Sedgebrook..	2·45	62	104	*Yorks*	Sedbergh, Akay	2·03	52	45
,, .	Eye, Northolm.....	1·92	49	...	,, .	Wath-upon-Dearne ...	1·30	33	52
Beds.	Woburn, Crawley Mill.	2·85	73	121	,, .	Bradford, Lister Pk...	1·06	27	39
Cam.	Cambridge, Bot. Gdns.	1·66	42	77	,, .	Wetherby, Ribston H..	2·00	51	80
Essex	Chelmsford, County Lab	4·19	107	197	,, .	Hull, Pearson Park ...	1·44	37	62
,, .	Lexden, Hill House...	1·84	47	...	,, .	Holme-on-Spalding ...	·96	24	...
Suff .	Hawkedon Rectory ...	1·09	28	45	,, .	West Witton, Ivy Ho..	1·21	31	...
,, .	Haughley House.....	·93	24	...	,, .	Felixkirk, Mt. St. John	2·02	51	74
Norf.	Beccles, Geldeston....	1·65	42	71	,, .	Pickering, Hungate ...	1·36	35	...
,, .	Norwich, Eaton	1·68	43	65	,, .	Scarborough.....	...	..	...
,, .	Blakeney	1·74	44	77	,, .	Middlesbrough	2·89	73	113
,, .	Swaffham	1·61	41	63	,, .	Baldersdale, Hury Res.	1·18	30	38
Wilts.	Devizes, Highclere....	3·69	94	159	*Durh.*	Ushaw College	1·74	44	62
,, .	Bishops Cannings	4·62	117	185	*Nor .*	Newcastle, Town Moor.	2·07	53	78
Dor .	Evershot, Melbury Ho.	3·01	77	119	,, .	Bellingham, Highgreen	1·85	47	...
,, .	Weymouth, Westham..	...	..	...	,, .	Lilburn Tower Gdns...	1·62	41	...
,, .	Shaftesbury, Abbey Ho.	2·82	72	110	*Cumb*	Geltsdale.....	1·97	50	...
Devon	Plymouth, The Hoe...	2·86	73	103	,, .	Carlisle, Scaleby Hall .	2·20	56	67
,, .	Polapit Tamar	4·71	120	175	,, .	Seathwaite M.....	3·70	94	44
,, .	Ashburton, Druid Ho..	3·80	97	125	*Glam.*	Cardiff, Ely P. Stn.....	4·13	105	133
,, .	Cullompton	3·13	79	116	,, .	Treherbert, Tynywaun	4·78	121	...
,, .	Sidmouth, Sidmount ..	2·51	64	100	*Carm*	Carmarthen Friary....	2 49	63	71
,, .	Filleigh, Castle Hill ...	4·27	109	...	,, .	Llanwrda, Dolaucothy.	4·29	109	99
,, .	Barnstaple, N.Dev.Ath.	3·41	87	126	*Pemb*	Haverfordwest, School	2·72	69	...
Corn.	Redruth, Trewirgie ...	4·32	110	142	*Card.*	Gogerddan.....	2·78	71	72
,, .	Penzance, Morrab Gdn.	2·69	68	99	,, .	Cardigan, County Sch. .	3·85	98	...
,, .	St. Austell, Trevarna..	4·16	106	124	*Brec .*	Crickhowell, Talymaes	2·75	70	...
Soms	Chewton Mendip	5·61	143	161	*Rad .*	Birm. W. W. Tyrmynydd	3·30	84	80
,, .	Street, Hind Hayes ...	2·89	73	...	*Mont.*	Lake Vyrnwy	1·76	45	51
Glos..	Clifton College	3·47	88	123	*Denb.*	Llangynhafal	4·25	108	...
,, .	Cirencester	3·17	81	120	*Mer .*	Dolgelly, Bryntirion..	3·96	101	93
Here.	Ross, Birchlea	2·43	62	107	*Carn.*	Llandudno	2·89	73	21
,, .	Ledbury, Underdown.	2·50	63	111	,, .	Snowdon, L. Llydaw 9	9·05	230	...
Salop	Church Stretton.....	2·44	62	100	*Ang .*	Holyhead, Salt Island.	2·21	56	85
,, .	Shifnal, Hatton Grange	3·13	79	139	,, .	Lligwy	1·79	45	...
Staff.	Tean, The Heath Ho...	2·47	63	85	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	3·06	78	143		Douglas, Boro' Cem...	2·46	62	80
,, .	Blockley, Upton Wold.	3·53	90	145	*Guernsey*				
War.	Farnborough.....	4·64	118	181		St. Peter P't, Grange Rd	2·52	64	125

Rainfall: July, 1925: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	2·51	64	87	*Suth.*	Loch More, Achfary...	4·10	104	77
,, .	Pt. William, Monreith .	2·57	65	...	*Caith*	Wick	3·05	77	116
Kirk.	Carsphairn, Shiel.	2·66	68	...	*Ork .*	Pomona, Deerness	1·74	44	68
,, .	Dumfries, Cargen.....	2·04	52	63	*Shet .*	Lerwick	1·66	42	72
Dum	Drumlanrig	2·92	74	85					
Roxb	Branxholme	1·34	34	44	*Cork.*	Caheragh Rectory	4·12	105	...
Selk .	Ettrick Manse.....	1·84	47	...	,, ..	Dunmanway Rectory.	3·21	81	82
Berk.	Marchmont House	2·01	51	66	,, ..	Ballinacurra	2·72	69	97
Hadd	North Berwick Res....	1·42	36	55	,, ..	Glanmire, Lota Lo. ...	3·12	79	108
Midl	Edinburgh, Roy. Obs..	1·92	49	74	*Kerry*	Valencia Obsy.	4·01	102	106
Lan .	Biggar	2·05	52	71	,, .	Gearahameen	8·30	211	...
Ayr .	Kilmarnock, Agric. C..	2·63	67	85	,, .	Killarney Asylum.....	4·91	125	148
,, .	Girvan, Pinmore.....	2·49	63	68	,, .	Darrynane Abbey	5·25	133	138
Renf.	Glasgow, Queen's Pk..	1·71	43	59	*Wat .*	Waterford, Brook Lo..	2·41	61	74
,, .	Greenock, Prospect H..	2·23	57	57	*Tip .*	Nenagh, Cas. Lough...	2·87	73	91
Bute.	Rothesay, Ardencraig.	2·30	58	58	,, .	Tipperary	3·75	95	...
,, .	Dougarie Lodge	2·49	63	...	,, .	Cashel, Ballinamona ..	2·34	59	81
Arg .	Ardgour House	4·14	105	...	*Lim .*	Foynes, Coolnanes	4·13	105	134
,, .	Manse of Glenorchy..	3·42	87	...	,, .	Castleconnell Rec.	3·64	93	...
,, .	Oban	2·98	76	...	*Clare*	Inagh, Mount Callan ..	6·30	160	...
,, .	Poltalloch	4·29	109	105	,, .	Broadford, Hurdlest'n.	3·47	88	...
,, .	Inveraray Castle.....	3·97	101	80	*Wexf*	Newtownbarry	...	..	...
,, .	Islay, Eallabus.....	4·35	111	128	,, .	Gorey, Courtown Ho...	2·02	51	69
,, .	Mull, Benmore	8·30	211	...	*Kilk.*	Kilkenny Castle	2·28	58	81
Kinr.	Loch Leven Sluice	1·35	34	47	*Wic .*	Rathnew, Clonmannon	2·65	67	...
Perth	Loch Dhu	2·65	67	55	*Carl.*	Hacketstown Rectory .	3·82	97	111
,, ..	Balquhidder, Stronvar.	2·55	65	59	*QCo..*	Blandsfort House.....	2·36	60	75
,, ..	Crieff, Strathearn Hyd.	2·99	76	101	,,	Mountmellick	...	..	...
,, ..	Blair Castle Gardens ..	2·38	61	93	*KCo.*	Birr Castle.....	3·96	101	134
,, .	Coupar Angus School..	2·83	72	120	*Dubl.*	Dublin, FitzWm. Sq...	2·65	67	104
Forf.	Dundee, E. Necropolis.	1·76	45	64	,, .	Balbriggan, Ardgillan .	3·11	79	115
,, .	Pearsie House.....	1·74	44	...	*Me'th*	Drogheda, Mornington	3·16	80	...
,, .	Montrose, Sunnyside..	2·05	52	78	,, .	Kells, Headfort.....	3·20	81	101
Aber.	Braemar, Bank	3·14	80	123	*W.M*	Mullingar, Belvedere .	2·86	73	90
,, .	Logie Coldstone Sch. ..	1·99	51	67	*Long*	Castle Forbes Gdns....	3·60	91	115
,, .	Aberdeen, Cranford Ho	...	..	...	*Gal .*	Ballynahinch Castle ..	7·98	203	192
,, .	Fyvie Castle	3·11	79	...	*Mayo*	Mallaranny.....	7·12	181	...
Mor .	Gordon Castle.....	4·00	102	125	,, .	Westport House.....	5·02	127	162
,,	Grantown-on-Spey....	2·82	72	92	,, .	Delphi Lodge	8·09	205	...
Na .	Nairn, Delnies.....	1·90	48	71	*Sligo*	Markree Obsy.	3·92	100	114
Inv..	Ben Alder Lodge	1·83	47	...	*Cav'n*	Belturbet, Cloverhill..	3·76	95	120
,, .	Kingussie, The Birches	2·31	59	...	*Ferm*	Enniskillen, Portora ..	3·70	94	...
,, .	Loch Quoich, Loan....	5·00	127	...	*Arm.*	Armagh Obsy.	3·78	96	131
,, .	Glenquoich	3·76	95	59	*Down*	Warrenpoint	3·84	97	...
,, .	Inverness, Culduthel R.	2·32	59	...	,, .	Seaforde	4·77	121	150
,, .	Arisaig, Faire-na-Squir	3·19	81	...	,, .	Donaghadee, C. Stn...	2·15	55	77
,, .	Fort William.....	2·70	69	56	,, .	Banbridge, Milltown .	4·85	123	149
,, .	Skye, Dunvegan.....	4·19	106	...	*Antr.*	Belfast, Cavehill Rd. .	4·59	117	...
,, .	Barra, Castlebay	2·72	69	...	,, .	Glenarm Castle.....	2·28	58	...
R&C	Alness, Ardross Cas. ..	2·90	74	96	,, .	Ballymena, Harryville	4·49	114	131
,, .	Ullapool.....	2·67	68	...	*Lon .*	Londonderry, Creggan	3·67	93	100
,, .	Torridon, Bendamph..	3·60	91	66	*Tyr .*	Donaghmore	3·48	88	...
,, .	Achnashellach	3·15	80	...	,, .	Omagh, Edenfel	...		...
,, .	Stornoway	2·08	53	69	*Don .*	Malin Head	3·77	96	133
Suth.	Lairg	1·96	50	...	,, .	Rathmullen.....	4·70	119	...
,, .	Tongue Manse.....	2·74	70	90	,, .	Dunfanaghy	4·07	103	118
,, .	Melvich School.....	2·75	70	98	,, .	Killybegs, Rockmount.	4·32	110	98

Climatological Table for the British Empire, February, 1925

STATIONS	PRESSURE		TEMPERATURE						Mean	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values											
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1005·1	−10·9	54	29	47·6	37·7	42·7	+ 2·6	39·4	88	7·3	81	+ 42	17	2·1	22
Gibraltar	1021·3	+ 1·3	65	44	60·8	48·4	54·6	− 1·3	48·4	83	5·3	80	− 27	14	...	...
Malta	1019·0	+ 2·3	66	43	60·4	51·2	55·8	+ 0·5	50·7	78	5·1	29	− 27	9	6·2	57
Sierra Leone	1012·1	+ 1·1	97	67	90·0	72·8	81·4	− 0·9	74·2	72	3·5	0	− 7	0	...	...
Lagos, Nigeria	1009·5	− 0·6	92	72	89·6	75·1	82·3	+ 0·2	75·9	84	6·9	10	− 41	1	...	...
Kaduna, Nigeria	1014·7	+ 2·7	93	...	88·9	...	...	...	53·1	28	0·9	0	− 1	0	...	...
Zomba, Nyasaland	1008·7	0·0	83	62	79·8	65·4	72·6	+ 0·8	...	91	8·8	243	− 31	25	...	...
Salisbury, Rhodesia	1008·7	− 0·7	79	55	76·4	60·0	68·2	− 0·7	62·6	79	7·4	255	+ 73	20	5·7	45
Cape Town	1013·1	− 0·2	102	53	84·2	62·0	73·1	+ 2·6	63·9	74	2·5	5	− 8	3	...	...
Johannesburg	1012·7	+ 1·4	85	52	76·6	56·6	66·6	+ 1·2	59·5	77	5·6	112	− 18	8	7·7	59
Mauritius	1011·9	+ 0·9	89	68	85·6	71·6	78·6	− 0·7	73·9	67	5·7	24	−189	15	9·1	72
Bloemfontein	...	...	93	56	83·7	59·9	71·8	− 0·1	63·2	65	3·4	55	− 33	10	...	...
Calcutta, Alipore Obsy.	1012·5	− 0·8	89	52	82·2	59·3	70·7	− 0·3	69·3	84	3·4	6	− 22	1*	...	...
Bombay	1012·4	− 0·3	87	60	81·1	65·5	73·3	− 2·3	62·1	69	0·8	0	− 1	0*	...	...
Madras	1012·5	− 0·4	94	62	87·4	66·4	76·9	− 0·8	70·8	82	2·4	0	− 8	0*	...	...
Colombo, Ceylon	1010·4	− 0·7	91	63	87·4	71·1	79·3	− 0·4	74·6	69	4·8	178	+133	8	7·9	66
Hong Kong	1019·3	+ 0·6	71	40	60·4	52·5	56·5	− 2·6	50·8	69	7·7	10	− 31	6	4·1	36
Sandakan	...	...	87	71	85·3	74·5	79·9	− 0·2	76·1	86	...	388	+144	13	...	...
Sydney	1010·0	− 4·0	87	59	79·9	65·3	72·6	+ 1·4	66·7	60	5·0	49	− 63	9	8·4	63
Melbourne	1011·0	− 3·5	89	48	76·4	58·3	67·3	− 0·1	59·5	65	6·9	29	− 15	11	7·0	50
Adelaide	1012·2	− 2·1	95	53	80·7	60·5	70·6	− 3·5	61·1	53	6·7	155	+138	6	7·4	56
Perth, W. Australia	1010·4	− 2·6	98	51	82·1	60·5	71·3	− 2·8	62·0	54	3·9	6	− 6	4	9·6	73
Coolgardie	1010·6	− 1·9	101	51	84·5	59·5	72·0	− 4·0	59·7	53	4·3	94	+ 75	7	...	...
Brisbane	1010·3	− 2·2	106	64	86·6	70·2	78·1	+ 1·8	72·1	69	5·5	71	− 90	13	7·9	61
Hobart, Tasmania	1008·1	− 5·4	79	43	68·3	53·8	61·1	− 1·3	54·5	67	7·8	34	− 3	11	5·7	42
Wellington, N.Z.	1011·4	− 3·9	75	46	69·3	55·6	62·5	+ 0·1	57·4	65	5·3	99	+ 16	10	7·8	57
Suva, Fiji	1007·9	+ 0·2	91	70	88·4	72·3	80·3	− 0·2	76·5	79	5·3	210	− 47	18	...	...
Apia, Samoa	1009·6	+ 1·2	89	73	85·5	75·1	80·3	+ 1·3	77·4	76	5·8	169	−230	18	6·8	54
Kingston, Jamaica	1015·1	− 0·2	87	64	84·3	66·0	75·1	− 1·4	62·9	78	2·6	23	+ 8	5	...	...
Grenada, W.I.	1014·5	+ 1·1	85	68	82·4	70·9	76·7	− 0·3	71·7	72	4·9	32	− 40	7	...	...
Toronto	1016·5	− 1·5	50	2	33·9	20·9	27·4	+ 5·7	22·8	66	8·5	91	+ 25	16	3·4	33
Winnipeg	1018·6	− 3·2	41	−31	13·0	−4·5	4·3	+ 4·9	...	...	5·7	14	− 6	12	3·3	33
St. John, N.B.	1016·3	+ 2·2	49	−8	34·8	20·2	27·5	+ 7·6	23·6	73	7·4	76	− 23	18	3·7	36
Victoria, B.C.	1012·0	− 3·9	54	36	48·5	40·0	44·3	+ 4·0	40·2	89	8·0	61	− 29	17	2·7	27

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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The Border-Line between Meteorology and Soil Physics

By DR. B. A. KEEN,

Assistant Director and Head of the Soil Physics Department, Rothamsted Experimental Station.

IT would not be correct to say that the meteorologist loses interest in the rain once it has fallen, and the farmer, except at harvest time, has no interest in rain until it has fallen and entered the soil; nevertheless there is a good deal of truth in the statement, and the difference in the interest of these two classes is shown by the fact that the border-line—the relations between precipitation and the amount of moisture in the soil under varying conditions—has been little explored. The purpose of this short article is to discuss in a simple manner some of the investigations in the Soil Physics Department at Rothamsted, and elsewhere, that fall on this border-line.

The farmer is concerned with the moisture content of the top few feet of soil, and is not interested in the moisture that penetrates to lower depths except in so far as this may subsequently become available for farm purposes by pumping, or in low-lying places by ponds, or by capillary action to the plant roots in periods of drought. For agricultural purposes, therefore, it is important to know approximately what proportion of the rainfall is left behind in the upper layers of the soil. The records of the Rothamsted drain gauges give invaluable aid in this respect. They were erected in 1870, and consist of three blocks of bare

Wt 69—P 1 1000 9/25 M & C

and undisturbed soil 1/1000 acre in area and respectively 20 in., 40 in. and 60 in. in depth. Collecting and measuring vessels were installed in special chambers underneath each of these blocks. The long series of records from these gauges enable reliable average values to be obtained. Taking the figures on a yearly basis, and dividing them into three groups of low, normal and heavy rainfall, we obtain the following results :—

	Rainfall	Drainage		Evaporation
	in.	in.	%	in.
Below 26 in.	23·67	10·12	42·8	13·55
26 in.—30 in.	28·49	14·08	49·4	14·41
Above 30 in.	33·62	17·66	52·5	15·96

Thus, in the Rothamsted soil, a heavy loam typical of large areas in the country, about half of the rainfall appears as percolation water. The percentage increases with increase in the annual rainfall, as could be expected, since wet years are usually below the average in sunshine, and evaporation is correspondingly reduced. The fifth column headed " evaporation " is the difference between yearly rainfall and yearly percolation. It is not an absolutely exact measurement of the evaporation as it implies the assumption that the actual moisture content of the block of soil at the end of the year is always constant. This is sufficiently near the truth when dealing with yearly averages.

The proportions of drainage and evaporation naturally differ from month to month. Average values are shown in the follow-

MONTHLY AMOUNTS OF DRAINAGE THROUGH 60 INCHES OF SOIL. AVERAGE OF 45 YEARS (1870-1, 1914-5).

Month	Rainfall	Drainage	Drainage	Evaporation
	in.	in.	%	in.
September ..	2·30	0·64	27·8	1·66
October ..	3·27	1·69	51·8	1·58
November ..	2·81	2·04	72·6	0·77
December ..	2·78	2·29	82·4	0·49
January ..	2·31	1·97	85·3	0·34
February ..	2·01	1·49	74·1	0·52
March ..	2·04	1·13	55·4	0·91
April ..	1·87	0·55	29·4	1·32
May ..	2·07	0·50	24·2	1·57
June ..	2·44	0·65	26·6	1·79
July ..	2·58	0·60	23·3	1·98
August ..	2·66	0·62	23·3	2·04

ing table ; the approximate nature of the figures in the last column must again be remembered.

The trend of the seasonal fluctuations is clear from this table. In the summer the land is more or less dried out and only a small proportion of the rain percolates to a 60 in. depth. The rest is held by the soil and in large part evaporated again. With the approach of winter the evaporation is much reduced, and the moisture content of the soil increases towards its saturation value. Hence in the winter months percolation forms a high percentage of the rainfall.

There are certain respects in which the drain gauge conditions inevitably differ from those in the field. In the latter an unknown proportion of rain may run off along the surface to a lower contour whenever the rate of fall of the rain exceeds the rate at which the soil can absorb it. This is prevented in the drain gauge by the raised edges.

Another difference is inherent in the design of the drain gauges. Whereas in the field the soil material is generally continuous down to the ground water level, in the drain gauges it ceases at the bottom of the gauge. This difference has important significance in connexion with the vertical distribution of moisture in the soil. If a tube of soil previously saturated with water is allowed to stand in a vertical position with the bottom in water, it will begin to discharge at the lower end, and eventually the distribution of water will show a gradual decrease from the bottom to the top. If in addition the top of the tube has also been exposed to evaporation, the moisture content of the top layers of soil will show a sharper drop. In either case this gradient is maintained against the action of gravity by the surface tension effects due to the water films in the interstices between the particles assuming a curvature that increases with their distance from the bottom of the tube. It takes a long time for this equilibrium distribution to be established under laboratory conditions, and in the field it is never attained, owing to the alterations of temperature, changes in the intensity of evaporation and the intermittent disturbances due to rain.

The position is further complicated by the change in physical structure of the field soil at increasing depths. Unlike the soil in the tube which is uniform from top to bottom, in the field soil below the depth of cultivation a marked change in colour can be seen, and this is associated with other changes, such as a decrease in pore space and increase in clay content. The nearest approach to equilibrium moisture conditions is during a drought. In this connexion results obtained at Rothamsted on a fallow plot just before the break of the great drought of 1921, and during the recent drought (July, 1925), are of interest especially in com-

parison with the values for an adjacent plot carrying a thin crop of wheat.

Great Drought, 1921				July Drought, 1925			
Fallow		Cropped		Fallow		Cropped	
Depth	Moisture	Depth	Moisture	Depth	Moisture	Depth	Moisture
in.	%	in.	%	in.	%	in.	%
0—1¼	2·47			0—2	4·55	0—2	7·7
		0—4½	4·04				
1¼—4	17·81			2—4	4·75	2—4	7·05
				4—5	8·3	4—5	7·35
4—6½	15·41	4½—6¾	6·11				
				5—6½	15·4	5—6½	7·35
6½—9	15·85	6¾—9	11·06	6½—9	19·3	6½—9	8·2
9—13½	17·98	9—13½	13·54	9—13½	21·6	9—13½	12·1
13½—18	20·61	13½—18	14·09	13½—18	22·3	13½—18	15·0
18—27	26·18			18—24	26·0	18—24	15·3
						31—34	18·4

Near the surface the moisture content in the fallow soil falls off very rapidly. This is primarily due to the effects of winds and heat in drying the top layer which then acts as a dry mulch or blanket, and reduces the rate at which the moisture in the soil below this layer can evaporate. The division between the mulch and the soil is very sharp, the former being dry and dusty and the latter distinctly moist. Below the dry layer the water content increases slowly with depth as indicated by the laboratory experiment; but part of this increase is accounted for by the increase in clay content of the sub-soil, which makes the soil "heavier" and therefore able to hold larger amounts of water. Perhaps the most striking feature of the table is the difference between the fallow and cropped values. The latter are much lower over the top 18 in., and in the 1925 series are much more regular. This is due to the absorption by the roots which have reduced the moisture content fairly uniformly over their range of travel. The uniform moisture distribution extends to the top layer of the soil which is protected by the crop from the intense drying effect of wind and sun seen on the fallow soil.

This brings us naturally to the general question of movement of water in the soil. We have already touched on two important causes, evaporation at the surface and downward flow due to gravitation. When the pore space of a soil is full of water, the latter effect is comparatively simple, and in principle the ordinary

Poiseuille capillary tube law can be applied. The " capillary tubes " are irregular in length, width and direction, but a satisfactory statistical average can be used. Alternatively the problem can be attacked by postulating an " ideal soil," consisting of a mass of equal sized spheres packed together in a systematic manner. Calculation of dimensional properties of the pores between the spheres is then a matter of solid geometry. A monumental investigation of this nature made by Slichter in America in 1899 was closely followed experimentally by King, who was able in general to substantiate the conclusions for the flow of water through saturated soils. The main interest of this work, however, was in giving precision to questions of water-supply to fairly deep wells supplied by percolation along water bearing strata. It did not apply directly to water movements in the top layers of soil in which normally an appreciable proportion of pore space is occupied by air as shown in the following table :—

PORE SPACE, WATER CONTENT AND AIR CONTENT OF CERTAIN ROTHAMSTED SOILS.

	Loss on Ignition (Organic Matter etc.)	Volume Occupied in Natural State by		Volume of Water		Volume of Air	
		Solid Matter	Air and Water (Pore Space)	In Normal Moist State	After Period of Drought	In Normal Moist State	After Period of Drought
	% weight						
Arable— Unmanured	4·3	66	34	23	17	11	17
Arable—14 tons dung per annum	10·0	62	38	30	20	8	18
Pasture	13·0	53	47	40	22	7	25

In these conditions the water is distributed as a thin coating over the soil particles and tends to concentrate in the interstices between the grains, as already mentioned in the case of the vertical tube of soil. Movement of water then takes place either by distillation from a warmer to a cooler region or under the effects of surface tension, water being drawn from moisture regions where the curvature of the intersticial water wedges is less, to adjacent dryer spots where the shrunken films have a sharper curvature.

The former effect follows the diurnal temperature wave in its downward penetration in the day, and its upward flow at night ; the latter effect serves to promote a movement of water to an absorbing plant root from the immediate surrounding volume, and towards the surface of the soil when this is depleted of water by evaporation. Theoretical considerations and experiment both indicate that the distances over which appreciable water

movement can be initiated by these factors are very small: the plant root does not wait for, but goes in search of the moisture. On the other hand, the physical causes of water movement would appear to be of great importance in maintaining a proper environment for micro-organisms on which the fertility of the soil so largely depends; and the beneficial effect is naturally predominant in forms that are either non-motile or that pass through a non-motile stage.

We may also apply the above consideration to the question whether there is any appreciable upward movement of water to the surface from lower depths where the strata are saturated—*i.e.*, the ground water table. Diverse views have been expressed on this point, estimates of the maximum distance over which water can thus be raised varying from hundreds of yards to a few feet. Although the numerous laboratory experiments that have been made have suggested the lower value as correct, yet there has always remained the possibility that the values might be higher under field conditions. Results obtained in 1921, with a special form of soil tanks, would seem to dispose of this doubt. The tanks were cylindrical in form, 6 ft. deep by 2 ft. 6 in. in diameter, closed at the bottom and the top edge was at ground level. A thin layer of coarse gravel was spread over the bottom of each cylinder and the soil was carefully filled in. A vertical pipe 2 in. in diameter passed through the soil to the gravel layer, and by the aid of a long ruler the level of the water in this pipe could be measured at any time. The cylinders were left for some years for the contents to settle down before systematic readings were taken. In the winter of 1920-21, the soil was, as usual, saturated. It gradually dried out with the advent of spring, and the water level in the indicator pipe receded. Daily measurements of this change were made over the whole of the year. Over the drought period the level in the cylinder containing Rothamsted soil fell rapidly to about 28 in. below the surface in 30 days. Then the rate of fall diminished rapidly, and the water level had only receded a further 10 in. when the weather finally broke some 80 days later. The initial saturation of the soil and the sustained evaporation conditions of the drought were both favourable to a state of affairs in which the water raising power of the soil should show to advantage. The low values actually found demonstrate that especially in normal years, the moisture content of the top soil is not markedly affected by supply from below either by capillary action or by a movement of the water films over the soil grains.

This conclusion emphasises the importance of the moisture present in the top two or three feet of soil. If it is not appreciably added to from underground sources, but is dependent for additions on the rainfall, the danger to crops of drought periods and of

extensive evaporation from the soil surface is obvious. In practice we find, even in this country with its adequate and well-distributed rainfall, a vital necessity to adapt our cultivation operations so that the store of water in the top soil may be conserved.

The existence of a considerable volume of pore space in soils unoccupied by water raises the interesting question of the humidity of the soil air. Measurements on the vapour pressure of soil at different moisture contents indicate that the full value is attained at quite low moisture contents which are in fact below the optimum value for crop growth. For the Rothamsted soil the values lie between 6 per cent. and 8 per cent. depending on the amount of clay and organic matter present. Hence over the normal range of moisture content for satisfactory crop growth, the soil air is in contact with what is virtually a free water surface. Simple calculations show that the effective area of this water film stretched over the innumerable soil particles is very large; the individual pore spaces, although constituting in the aggregate some 30 per cent. to 40 per cent. of the soil volume, are very minute. Hence the soil air is practically always saturated with water vapour except in the top dried mulch. Alternations of barometer pressure and temperature changes promote an exchange of soil air and atmospheric air, but the approximate depth to which this takes place is still a matter of dispute. The above considerations, however, show that atmospheric air entering the soil is rapidly saturated with water vapour.

This brief review of certain borderline aspects of meteorology and soil physics has by no means covered even the main points of interest. Nothing at all has been said of the colloidal properties of soil and their effect on soil moisture relationships. This study is perhaps the fundamental characteristic of modern soil physics, and its importance can be gauged from the fact that practically all the matters discussed in the present article strictly apply not to soil but to moist sand. The water relationships of the latter material are comparatively simple, but they serve to illustrate the broad effects that occur in soil, and for purposes of simple presentation they have the advantage of freedom from the complex factors introduced when colloidal materials such as clay and organic matter have to be taken into account.

Meteorological Results of the Oxford University Arctic Expedition

THE Oxford University Arctic Expedition, under the leadership of Mr. George Binney, spent the summer of 1924 in Spitsbergen. Meteorological observations were taken on board the *Polar Bjorn* and *Oiland* in Spitsbergen waters and for six weeks at the head-

quarters of the expedition at Liefde Bay (79°42′ N, 13°48′ E) on the north coast. An aeroplane was employed for aerial surveying, and some upper air temperatures were obtained during the flights. The weather was regarded especially from the aviator's point of view throughout, and this constitutes the chief value of the record.

During August, observations at Liefde Bay are nearly complete at 13 h. and 18 h. G.M.T., and these give a mean pressure of 1008·3 mb. During the same month, the mean pressure at Green Harbour (78°2′ N) was 1009·1 mb. (provisional value), so that the average gradient was small. The winds were generally light and only one gale was recorded ; the most noticeable feature was the suddenness of the changes of direction and strength, winds of moderate strength frequently occurring between the times of observation. The mean temperature of 38° F. was about 3° F. below that at Green Harbour. The highest maximum at Liefde Bay was 50° F. and the lowest minimum 29° F., but an exceptional temperature of 58° F. was recorded on the *Oiland* in Treurenberg Bay. The sun was above the horizon continuously and there seemed to be more sunshine at " night " than during the day, but the thermograms usually show some indication of the diurnal variation of temperature, and this was well-marked on 10 days out of 46. There were 12 days of snow, but the total precipitation, some of which fell as rain, was only 18 mm. (0·72 in.). The weather was humid and cloudy and it was difficult to keep clothes dry.

The most valuable observations relate to the visibility, which was extraordinarily good except when interfered with by low cloud. At Liefde Bay, 66 per cent. of the observations in July and 44 per cent. of those in August gave a visibility exceeding 30 km., and on no occasion did the visibility fall below 1,000 metres. Mr. F. Tymms, the meteorologist of the expedition, continues: " There seems reason to believe that conditions differ widely between the west and north coasts. On the west coast definite fog was experienced, but on the north coast, though banks of fog, which appeared dense from a distance, were very frequently experienced, they were very patchy, never very high and never produced really low visibility . . . . I am certain that these fogs would prove no obstacle to aviation, because even if it were desired to land, clear areas could be found. These fog banks were always associated with a N to E wind, and were almost the invariable accompaniments of such a wind." During the six weeks at Liefde Bay, low cloud (below 1,500 ft.) was present during about 40 per cent. of the observations and often obscured distant high points. On the west coast dense fog (visibility 50 metres) was occasionally experienced. In

Hinlopen Strait to the north-east, the visibility was not generally so good as on the north coast.

The state of the ground, assuming that a level landing ground could be found, was generally unfit for the landing of aircraft. On July 9th, there was much drift snow and the remainder of the ground was very soft and muddy, and in spite of the good drainage qualities of the soil it was not until August 6th that the ground could be described as dry; most of the neighbourhood was again covered with snow by August 27th.

Unfortunately, it was not possible to carry out the full programme of meteorological observations by aeroplane, but enough were obtained to show that the vertical temperature gradient was slight. The following readings represent an ascent in an almost cloudless sky on August 30th:—

Ground	35° F.	3,000 feet	29° F.
1,000 feet	37° F.	3,800 feet	28° F.
2,000 feet	34° F.	8,000 feet	27° F.

The meteorological conditions during the summer of 1924, appear to have been about normal for the time of year, and the information collected by the expedition will be of considerable value for future aviation in the neighbourhood of Spitsbergen.

Correspondence

To the Editor, *The Meteorological Magazine*

Crepuscular Rays

AT 9.10 p.m. (Summer Time) this evening while the sun was still shining and the moon was high in a clear sky to the south-west, I happened to glance towards the south-east where there were several white and pink fleecy clouds. I noticed a dark band starting from the horizon and stretching upwards. The band was not vertical but inclined about 30° from the vertical and if produced would apparently reach the sun. It was very conspicuous against the background of light cloud and was even observable against the blue sky higher up. I can best describe it as a " reversal " of a sun pillar, except that it was not vertical.

After about five minutes, the clouds became darker, as the sun disappeared and the phenomenon gradually died out.

I should be interested to know whether this phenomenon has been observed by others.

W. A. KNIGHT.

Sexey's School, Bruton, Somerset. June 28th, 1925.

Meteoric Fireballs

YOUR interesting remarks* on detonating fireballs and the necessity for acquiring multiple observations will, I hope, cause observers to give special attention to the subject. The importance of correctly deriving the velocity of sound in the upper atmosphere is admitted and the problem is one not very difficult to solve. In past years the available records have been inadequate to meet requirements. Data were often inaccurate and incomplete and deductions more or less doubtful were the only ones derivable from them. If observers know exactly what details are to be noted in connexion with such phenomena they will no doubt strive to procure them, and thus effectively aid investigation.

Detonating meteors of large size are really more abundant than is supposed, but many of them pass without being fully described and are lost to science. Eight fireballs were reported to me during the last quarter, as follows:—

Date.	Time (G.M.T.).	Brightness.	Place of Observation.
1925.	h. m.		
March 22nd ..	21 35	¼ Moon	Oxley, Yorks.
April 4th ..	19 50	Greater than Venus	Croydon, Surrey.
12th ..	21 40	= Moon	S.W. England.
16th ..	1 15	= Moon	,,
20th ..	23 38	5 times Venus	Ashby, Linc.
June 4th ..	16 10	= Moon	Cornwall & S. Wales.
5th ..	21 55	= Moon	S.W. England.
14th ..	1 30	= Venus	Bristol.

Three of the above objects were detonating, and in five cases out of the eight it was found impossible to compute the real paths owing to the lack of necessary observations. With regard to the instances in which the meteors detonated the time intervals stated to have passed between the flashes and the explosions were merely rough estimates which differed materially and could not be harmonized.

W. F. DENNING.

Horfield, Bristol. July 22nd, 1925.

* See *Meteorological Magazine* 60 (1925), 145.

Red Lightning

IN May, 1867, the first 10 days saw a spell of phenomenal heat. On the 10th a short sharp thunderstorm broke over Cambridge and district just before noon with serious casualties from lightning. This first storm soon cleared off; but in the late afternoon as I walked back into Cambridge from Trumpington, it was thundering loudly and it appeared to my eyes that horizontal flashes, beyond counting, of dull red lightning were darting across the street at about 6 feet from the ground. One could have thought that these flashes were being fired from the ground floor windows on either side. It continued to thunder overhead, but independently of the lightning. It was a terrifying experience. I hurried to my rooms at Emmanuel College, just in time to escape a heavy downpour of rain and hail. The storm lasted well into the night, and made a big flood in the Cam. Details of this storm are given in *British Rainfall*, 1867, p. 59. The rain is given as 1·15 in. at Brook House. No mention is made of red lightning, but in other respects that account agrees closely. The dull red flashes were seen in broad daylight about 6.30 p.m., not against the sky, but against the houses, and were devoid of any illuminating brightness.

On April 30th, 1875, I had a like experience with very different surroundings. I was then living at Patras in Greece, and had come, in weather unusually wet for that time of year, over the passes of Mt. Erymanthus to Olympia. We crossed almost without notice two small gullies, quite close together, nearly if not quite dry. The morning had been very fine, but now at about noon clouds gathered fast, and a violent thunderstorm was soon raging with very heavy rain and hail. It soon became clear that the streams ahead would be quite impassable. There was nothing for it but to return. Arrived at the first of the aforesaid gullies we found a dangerous looking torrent through which we hurried. But on coming to the second gully we found it quite hopeless to cross it. There we had to wait in the pouring rain and hail, the thunder echoing from the steep rocky sides of the narrow valley, and again dull red horizontal flashes appeared to be darting across the valley at a low level, countless in number, and seemingly independent of the thunder overhead, and were seen against a background of pines and rocks. After perhaps an hour's waiting the sky began to clear, the sun soon shone brightly, the torrent abated as fast as it had risen, and we returned through Krestena, where there was loud lamentation because of the destruction in the vineyards by the hail. The high proportion of hail to rain is shown by the temperature of the torrent in the gully, which was 36° though it is but 300 ft. above sea level. The next day was gloriously fine.

On Sunday, May 13th, 1906, there was a notable thunderstorm in Somerset. At Melles and also at Downside 3 in. of rain fell (vide *British Rainfall*). At North Cadbury the fall was 1·19 in. between 4.30 p.m. and 11 p.m. Thunder and lightning were incessant from 3.30 till 11; the bulk of the rain fell between 4.30 and 6. Evensong began in the church at 6 with a sadly depleted congregation, and from the pulpit at 6.45 I had my third experience of red lightning, for I could see through the windows dull red horizontal flashes which seemed to be darting about the churchyard; and later till it was dusk the whole country-side seemed to be full of this dull red lightning, apparently independent of the thunder. From time to time there were bright flashes of ordinary colour almost simultaneous with the thunder, but the non-luminous character of the red lightning was very noticeable.

It will be observed that in each of these three cases of red lightning it was broad daylight, but even so the non-luminous character of these horizontal flashings near the ground was remarkable. I can but record from notes made at the time what I thought I saw. Can any of your readers throw any light on the real nature of this, I suppose, rare phenomenon, or say whether it was as dangerous as it looked?

H. A. BOYS.

Spring Hill, S. Mary Bourne, Andover. July 13th, 1925.

Waterspouts observed at the Isle of Man

I WITNESSED two waterspouts from the promenade here this evening. The first one commenced to develop at 6.25 p.m., B.S.T., at a spot situated roughly 10 miles south magnetic from Port St. Mary breakwater light, and travelled at a rapid rate in an easterly direction, finally disappearing at 6.35 p.m., when it bore roughly south-east magnetic from the above-mentioned lighthouse. The second one started at 6.40 p.m. at a spot situated about midway between the starting and finishing points of the first one. It travelled in the same direction and at about the same rate as the first one, finally disappearing in about the same position at 6.45 p.m.

The weather at the time was sultry with a suggestion of rain; the clouds in the region of the waterspout were very heavy and lowering with jagged edges; the sea was very smooth and the wind NW light breeze. The portions of the spouts proceeding from the clouds were more defined than those proceeding upward, and the tips in each instance appeared to revolve with a pendulum motion, as though suspended by the base in the clouds.

W. H. TOTTEY.

The Quay, Port St. Mary, Isle of Man. July 26th, 1925.

Mammato-Cumulus Cloud at Cranwell, Lincolnshire

As the result of an almost continuous watch kept upon the face of the sky at Cranwell, Lincolnshire, 12 examples of mammato-cumulus cloud were observed during the period January 1st, 1920, to July 10th, 1925. In view of the rarity of this particular cloud, some analysis of the meteorological conditions prevailing at, or near the times of occurrence of the 12 appearances, may not be without interest.

The surface winds prevailing at the actual times of occurrence were as follows :—

Between	W and N	(inclusive)	on 7	occasion(s).
,,	N and E	,,	0	,,
,,	E and S	,,	1	,,
,,	S and W	,,	4	,,
	CALM		1	,,

The fact that, of the 12 cases, only one occurred with any easterly component in the surface winds seems noteworthy.

Of the 12 days upon which the phenomenon was observed, precipitation occurred on 10 days. On 3 days only it fell at the actual time of occurrence of the cloud. On only one of the 12 days did thunderstorms actually occur at Cranwell ; but the Daily Weather Reports issued by the Meteorological Office, show that on 5 of the days storms occurred in either the midland, eastern or south-eastern districts of England, this number including the 1 case in which a storm was actually over Cranwell. On 7 of the 12 days cumulo-nimbus cloud was observed at some time or other. On 2 occasions it both preceded and followed the occurrence of the mammato-cumulus ; on 2 it preceded only ; and on 3 it followed only.

In 2 cases line squalls occurred within the hour preceding the noting of the mammato-cumulus cloud. In no other case did line squalls occur at any time during the day of the appearance of mammilation.

With regard to the map conditions prevailing, 8 of the 12 cases could definitely be associated with the rear of depressions, 3 with the fronts of depressions, and 1 with a col.

W. H. PICK.
G. A. WRIGHT.

R.A.F. (Cadet) College, Cranwell, Lincolnshire. 10th July, 1925.

Rain from a Blue Sky

I WAS surprised on July 18th at 15h. 16m. G.M.T. to find a shower falling from what to all appearances was a perfectly blue sky. I was at Boveysand (2½ miles from Cattewater) when

large drops of rain caused me to look up and observe that the sky was clear with the exception of cumulo-nimbus on the horizon and a small amount of alto-cumulus some distance ahead and receding towards the east. The latter was at a height of, approximately, 12,000 ft. Only about twenty yards of the ground, which was cemented concrete, showed the track of the shower. It was, then, a slight very short and very local fall of rain.

Weather conditions favoured the occurrence of local showers and some did fall in the forenoon but with the one exception noted above no precipitation took place in the Boveysand or Plymouth districts during the whole afternoon or evening, all the orthodox rain clouds remaining on the horizon. Up to 6,000 ft. at least a west-south-west sea-breeze prevailed. This would bring a certain amount of moisture-laden air, but readings at Cattewater show the relative humidity to have been between 60 per cent. and 70 per cent. with a temperature of a little over 60° F. By 15h. the sea would most likely have become warmer than the land; yet the westerly wind persisted. It has been noticed on several occasions that winds behave curiously along the cliffs at Boveysand. For instance, a fire lighted on the southern end of the cliff in an afternoon gives a volume of smoke which has been observed to drift, in a south-west wind, over the eastern slope and disappear and to appear again a short distance away drifting over the western cliff, even though the wind persisted from southwest. It is suggested that such conditions may have existed at a greater height on the 18th, and that the warmer more humid sea air was condensed by the comparatively cooler air which thus "overflowed" as it were from the land, causing the very local shower on the western side of the cliff, the cloud being too thin to be visible.

T. H. APPLEGATE.

Cattewater, Plymouth, July 24th, 1925.

Corrigendum

WE regret that the authority for the data for Johannesburg, which appears regularly in the "Climatological Table for the British Empire," was erroneously stated, on p. 155 of the *Meteorological Magazine* for July, to be the Chief Meteorologist, Pretoria. The data are supplied regularly by the Union Astronomer, Union Observatory, Johannesburg.

NOTES AND QUERIES

A New Form of Nephoscope

AN interesting description has recently been received of a new and inexpensive type of nephoscope designed by Major Agostinho, of the Azores Meteorological Service.

The principle of the instrument is similar to that of the Hill mirror, in so far as observations are made on the reflection of a portion of cloud.

The apparatus, in its simplest form, consists of a small wooden box, the bottom of which is covered by a plane mirror, 22 cm. square, and the lid of which is a sheet of glass parallel to the mirror and 4 cm. above it. When in use, a mark is made in the centre of the glass, and the reflection of this mark in the mirror aligned with the image of the portion of cloud under observation. The point at which the line joining these two images cuts the glass is marked by an ink spot. After a definite time, say one minute, has elapsed, and the cloud has moved through a certain distance, another observation is taken, and a similar mark made. If the distance between the two points is measured on the surface of the glass, the velocity-height-ratio of the cloud may be easily calculated from considerations of the dimensions of the instrument. The direction of motion is, of course, parallel with the line joining the two points.

Vertical Currents

THE results of pilot balloon ascents made on June 4th, 1925, at Larkhill (Salisbury Plain), appear to confirm the occurrence of descending currents in the lowest kilometre of the atmosphere in an anticyclonic area. It will be seen from the table that the descending currents presisted throughout the greater part of the day, extending roughly from 3,000 feet to the ground and that at times they were as strong as 6·3 feet per second. The sky was practically cloudless, occasional small amounts of fracto-cumulus being observed towards the horizon so that the effects cannot be ascribed to descending currents associated with the gaps between cumulus clouds. The effects were not due to contour, the ground being generally slightly higher to the north and north-west of this station. Unfortunately owing to the light winds which were prevalent on this day no reliable estimates of ascending or descending currents are available from other pilot balloon stations. On the preceding day there were ascending currents of small amount up to 1,000 feet but from 1,000 to 3,000 feet descending currents of one to four feet per second

were observed with a fairly steady wind from west-southwest. On June 5th the centre of the anticyclone had moved from the English Channel to Denmark, and the descending currents were neither strong nor persistent.

PILOT BALLOON ASCENTS (TAIL METHOD), JUNE 4TH, 1925

Time	10h. 45m. G.M.T.				11h. G.M.T.				12h. 40m. G.M.T.			
	Height	Wind Direction	Wind Speed	Vertical current	Height	Wind Direction	Wind Speed	Vertical current	Height	Wind Direction	Wind Speed	Vertical current
(min.)	(ft.)	°	(ft/s.)	(ft/s.)	(ft.)	°	(ft/s.)	(ft/s.)	(ft.)	°	(ft/s.)	(ft/s.)
0	Surface	175	4	—	Surface	219	11	—	Surface	190	9	—
1	500	194	7	0	450	204	7	—0·8	350	181	12	—2·5
2	800	205	9	—3·3	700	157	11	—4·2	626	164	13	—3·7
3	1,190	203	11	—1·8	820	159	11	—6·3	990	169	13	—2·3
4	1,600	198	8	—1·5	1,000	164	12	—5·3	1,380	151	12	—1·8
5	2,095	184	11	—0·1	1,400	164	12	—1·7	1,650	149	10	—3·8
6	2,600	172	12	0·1	1,940	173	13	0·7	2,000	172	12	—2·5
7					2,350	167	15	—1·5	2,290	170	19	—3·5
8					3,000	139	18	2·5	2,550	163	17	—4·0
9					3,510	139	18	0·2	2,910	156	16	—2·3
10					4,000	145	20	—0·2	3,610	156	16	3·3
11					4,460	152	25	—0·7	4,230	166	21	2·0
12					5,030	148	22	1·2	4,760	163	23	0·5

R.P. 3.

The Climates of Paris and London

IN a recently published analysis of the records of rainfall at Paris for the last 50 years,* Dr. Louis Besson has made use of the *British Rainfall* classification of "rain spells" and "wet spells."† He finds that the number of rain spells in 100 years at Paris was 10 but that wet spells are unknown. For comparison, Besson quotes the figures for 100 stations given in *British Rainfall*, 1921, thereby illustrating the difference between the climates of Paris alone and the whole of the British Isles. It is perhaps more appropriate to bring the statistics for a single London station for a long run of years into the comparison. In *British Rainfall*, 1922 (p. 9), the results of an analysis of the Camden Square figures for the 35 years 1881-1915 are set out as well as those for a wet station, Crossmolina, in the north-west of Ireland. At Camden Square there were 4 rain spells but no wet spells in the 35 years. On the evidence available there is nothing to choose between Paris and London. Some details

* Ann. Serv. Tech. Hygiène Paris, Vol. 5, Paris, 1924.

† *A Rain Spell* is a period of at least 15 days to each of which is credited ·01 in. or more.

A Wet Spell is a period of at least 15 days to each of which is credited ·04 in. or more.

An Absolute Drought is a period of at least 15 days to none of which is credited ·01 in. of rain or more.

A Partial Drought is a period of 29 days, the mean rainfall of which does not exceed ·01 in.

A Dry Spell is a period of at least 15 days to none of which is credited ·04 in. of rain or more.

are given in the table below, based on 50 years' observations at Paris (1873-1922) and 35 at Camden Square (1881-1915).

	Number per annum.	
	Paris.	Camden Square.
Rain days	156	162
Wet days	109	115
Rain Spells	·10	·11
Wet Spells	0	0
Absolute Droughts ..	1·50	1·23
Partial Droughts ..	1·46	1·00
Dry Spells	2·82	2·89
Rainfall (inches) ..	22·8	24·5

From the other figures which have been transcribed here it appears there is a little more risk of absolute drought at Paris than in London. This may, however, be mostly a question of rain-gauge exposure. The risk of a " dry spell " is the same in the two cities.

Reviews

An Introduction to Fluid Motion. By W. N. Bond, B.A., D.Sc., F.Inst.P. 8vo., $7\frac{1}{4} \times 4\frac{3}{4}$, pp. 94. London: Edward Arnold & Co., 1925. Price 5s.

THIS little book aims at presenting " An introduction and a guide to one embarking on the advanced study of fluid motion." It is divided into five Chapters: I. Outline of the General Principles; II. Fluid Motion between Solid Boundaries; III. Surface Waves, and Motion in Channels and over Weirs; IV. The Motion of a Body through Fluid; V. The effect of Compressibility of the Fluid.

Under the heading of General Principles, the author discusses compressibility, viscosity, streamlines, turbulence, flow through orifices, and considerations of momentum. The second chapter contains an interesting discussion of manometers, an outline of the method of dimensions, which is freely used throughout the book, and some discussion of turbulent motion. The general nature of the remaining chapters can be gathered from their titles.

Throughout the book there are frequent references to experimental work, but the author has avoided burdening his work with too many details of laboratory technique, and has also avoided the opposite error of burdening the book with too much mathematical analysis. The topics discussed have been graded with much discretion, so that the earlier topics involve only the simple considerations, the difficulties which are bound up with viscosity, compressibility, etc., being discussed later.

The book should appeal to a wide public, and can be read with much profit by the meteorologist who wishes to attack his subject from the dynamical aspect. To those like the present writer, whose memory of Lamb's Hydrodynamics has become dulled through lack of use, this little book provides a most stimulating refresher.

It is a striking fact that hydrodynamics, which for a generation appeared to have attained something approaching finality, has, under the impetus of the development of aeronautics, attained a new lease of life, and some very striking new results have been described by G. I. Taylor and others in recent papers. To the student who wishes to read these later researches, Dr. Bond's book provides a most helpful introduction. There are frequent references to original papers throughout the book.

D. BRUNT.

Regenval in het Noordeliik deel van Sumatra's Oostkust. By Dr. J. Boerema. Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verh. No. 11. 8vo., 11×7, pp. IV+16 (Dutch)+15 (English). *Illus.* Albrecht & Co., Weltevreden. 1923.

THIS publication deals with the rainfall at some 300 stations along the east coast of northern Sumatra. The area extends over about 300 miles of coast and stretches about 100 miles inland. Statistics are given of the average annual and monthly rainfall, and of the number of rain-days, together with rainfall charts on a scale of about 27 miles to 1 in. The average utilised is that for the 20 years, 1901 to 1920. In order to obtain averages for stations with short records the following procedure was adopted. Means were evaluated for each of the groups of 5 years 1901 to 1905, 1906 to 1910, 1911 to 1915, and 1916 to 1920. Each of the four means was expressed as a percentage of the 20 year average and four maps constructed. These maps were utilised in correcting short records covering the 5, 10 or 15 years to the mean of 20 years. This was practically the same method as that employed by Dr. H. R. Mill in the Rainfall of the Exe Valley,* where data were not numerous. In working up the monthly data use was made of isomeric maps (*i.e.*, maps showing the average monthly fall as a percentage of the average). This method has recently been used with advantage in this country.†

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* *London Geo. J.* 34 (1909), 630.

† A new Method of Constructing Average Monthly Rainfall Maps. By M. de Carle S. Salter, London. *Q.J.R. Meteor. Soc.*, 47 (1921), 101.

The area under consideration lies between latitude 2° and 4° N, and the maximum rainfall takes place after the passage of the sun through the zenith at the end of March and the middle of September. The rainiest season is in October and November with a secondary maximum falling in April and May. Maps are given showing the months of maximum, minimum, secondary maximum and secondary minimum of rainfall. It is interesting to note that along a line drawn parallel to the coast about 40 miles inland the two minima have an equal value. To the west of this line, the June minimum is the primary one, while to the east it is secondary to the February minimum. The yearly distribution of rainfall was inserted graphically on a chart and those stations with similar distributions were assembled into one group. In all, 17 groups were isolated. For each group the means of the average monthly rainfall of all stations were evaluated and the final values for each class were indicated graphically on a map. This map, which is reproduced in the paper, also indicates the limits of each zone and forms a valuable contribution to the climatology of Sumatra. The yearly range of rainfall along the east coast of Sumatra is small, long periods of no rain such as occur at Java being unknown. Statistics are given of the maximum period of no rain at 7 stations for each month of the year. These figures are much more uniform than would be the case in the British Isles where such periods are rarer in the winter months than in the spring and summer. The paper contains a valuable series of maps and tables.

J.G.

News in Brief

We regret to announce the death on August 15th of Captain R. C. Warden, who has represented the Board of Trade on the Meteorological Committee since 1922.

During a thunderstorm at Cattewater, Plymouth, on August 6th, 26 mm. (1.02 in.) of rain fell in 2 hours, the extreme rate of fall being 4 mm. (.16 in.) in 3 minutes, *i.e.*, 80 mm. (3.20 in.) per hour.

We learn from Dr. Friedmann that a new Geophysical Observatory forming a local branch of the Geophysical Central Observatory at Leningrad was opened at Jakutsk (62°01′ N, 129°43′ E from Greenwich) on July 12th, 1925. At the present time the work of the new observatory is confined to meteorology and aerology but it is hoped that in the course of the next few years the observatory will be equipped for actinometrical, optical and magnetic observations.

The Royal Meteorological Society has awarded the Howard Prize for 1925 to Cadet H. W. Barnett of S.A.T.S. *General Botha*, South Africa, for the best essay on " Icebergs : their Distribution and Drift."

We learn with regret of the death on Saturday, August 29th, of Mr. F. J. Brodie, who retired in 1919 from the staff of the Meteorological Office after 50 years' service.

The Weather of August, 1925

DURING the first part of the month the weather was generally unsettled ; pressure was low off our western coasts and secondaries passed across the country. Rain fell almost daily in some places ; moderately heavy falls were recorded, among the largest being 31 mm. (1·22 in.) at Falmouth and Plymouth on the 5th, 34 mm. (1·34 in.) at Manchester on the 10th, 39 mm. (1·54 in.) at Blacksod Point on the 11th, 38 mm. (1·50 in.) at Eskdalemuir on the 12th. Thunderstorms occurred in many parts of the country on the 1st, 5th and 6th, and again on the 10th and 11th. There were bright periods during which good sunshine records were obtained.

On the 13th, an anticyclone began to spread eastward over the British Isles and the weather improved. From the 14th to the 17th there was very little rain, and on the 15th, 16th and 17th it was generally sunny and maximum temperatures of 80° F. and above were recorded at a few stations.

On the 18th, depressions over southern England and south-west Iceland displaced the anticyclone and renewed the unsettled weather ; thunderstorms occurred over the country, and rainfall was again rather heavy, especially in the south on the 23rd, when Calshot recorded 44 mm. (1·73 in.) and Guernsey 38 mm. (1·50 in.).

Towards the end of the month the Azores anticyclones spread north-eastward, causing fairer weather in the more southerly districts.

Pressure was slightly above normal at North Cape and Spitsbergen, and also over Spain and the Mediterranean, and slightly below normal over central Europe and Sweden. Over the British Isles the pressure deviations were very small. Temperature and rainfall were about normal, except in Spitsbergen, which was unusually warm. In Sweden, temperature averaged 2° F. above normal, the extremes ranging from 81° F. to 29° F. ; rainfall was about 20 mm. above normal in the north, but below in the remaining districts.

The early part of the month was marked by very stormy

weather over the central part of Europe. Damage by wind and rain was done to crops in Austria and Hungary at the beginning of the month; trees were uprooted in Paris by a gale accompanied by a heavy downpour; snowstorms in the Alps caused the deaths of five climbers.

On the 9th and 10th, severe thunderstorms occurred in northern Europe; much damage was done in Denmark and north Germany, several persons being killed by lightning. Near Uetersen and Neuendeich, a cloudburst accompanied by heavy hail wrecked some houses. A violent tornado visited Holland on the night of the 10th. Coming from the direction of Roosendal on the Belgian frontier it swept over the provinces of North Brabant (where, in the villages of Zeeland and Langenboom, three people were killed and others severely wounded) and Gelderland. The greatest damage was done at Borculo, whence the storm passed over Zutphen and Meppel in the province of Overyssel, finally drifting towards the North Sea near Groningen with diminished intensity. At Borculo not one house remained intact, and out of the 5,000 inhabitants, 2,000 were rendered homeless. The storm exercised an upward suction, the roofs of many houses being lifted bodily and deposited on the heath several hundred yards away.

After a period of good weather in the middle of the month, unsettled conditions recurred about the 21st and heavy rain fell in many districts, especially in Switzerland. By the 27th, the Danube, the Rhone and the Isar had risen 2 ft.

On the 27th, extremely heavy rain followed by a severe thunderstorm caused floods and landslides in Tokyo and Yokohama. Thousands of houses were partly submerged and 18 lives were lost.

The special message from Brazil states that rain was scarce generally; it was 33 mm. below normal in the north, 25 mm. in the centre, and 49 mm. in the south. In Rio de Janeiro for the first time since records have been taken no rain fell at all in August. Anticyclonic conditions persisted, the abnormal position of the Atlantic anticyclone causing the rapid absorption of the centres of depressions coming from the Pacific. Excepting the wheat in the extreme south the crops are generally affected by the continued deficiency of rainfall. At Rio de Janeiro the pressure was 0·4 mb. above normal and the temperature 2·5° F. above normal.

Rainfall August, 1925—General Distribution

England and Wales ..	101	per cent. of the average 1881-1915.
Scotland	81	
Ireland	69	
British Isles	89	

Rainfall: August, 1925: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square.....	2·71	69	123	*War.*	Birminghm, Edgbaston	2·95	75	109
Sur .	Reigate, Hartswood...	2·74	70	119	*Leics*	Thornton Reservoir ..	1·87	47	67
Kent.	Tenterden, View Tower	1 23	31	54	,, .	Belvoir Castle.....	1·45	37	55
,, .	Folkestone, Boro. San.	1·20	30	...	*Rut .*	Ridlington.....	2·10	53	...
,, .	Broadstairs, St. Peter's	1·34	34	65	*Linc.*	Boston, Skirbeck	1·44	37	60
,, .	Sevenoaks, Speldhurst.	2·05	52	...	,, .	Lincoln, Sessions House	1·35	34	55
Sus .	Patching Farm.....	3·82	97	152	,, .	Skegness, Estate Office.	1·68	43	69
,, .	Brighton, Old Steyne .	2·62	67	118	,, .	Louth, Westgate	·91	23	33
,, .	Tottingworth Park....	2·30	58	85	,, .	Brigg	1·83	47	66
Hants	Ventnor, Roy. Nat. Hos.	5·71	145	287	*Notts.*	Worksop, Hodsock....	1·76	45	72
,, .	Fordingbridge, Oaklnds	3·34	85	127	*Derby*	Mickleover, Clyde Ho..	3·26	83	120
,, .	Ovington Rectory	3·20	81	118	,, .	Buxton, Devon. Hos...	4·52	115	103
,, .	Sherborne St. John Rec.	3·17	81	131	*Ches.*	Runcorn, Weston Pt...	3·19	81	89
Berks	Wellington College...	3·12	79	134	,, .	Nantwich, Dorfold Hall	3·58	91	...
,, .	Newbury, Greenham..	2·31	59	88	*Lancs*	Manchester, Whit. Pk.	3·94	100	114
Herts.	Bennington House....	3·11	79	...	,, .	Stonyhurst College....	3·98	101	79
Bucks	High Wycombe	4·03	102	174	,, .	Southport, Hesketh...	3·58	91	103
Oxf..	Oxford, Mag. College..	2·15	55	96	,, .	Lancaster, Strathspey.	3·54	90	...
Nor .	Pitsford, Sedgebrook..	1·59	40	66	*Yorks*	Sedbergh, Akay	5·06	129	90
,, .	Eye, Northolm.....	1·84	47	...	,, .	Wath-upon-Dearne ...	2·21	56	92
Beds.	Woburn, Crawley Mill.	2·33	59	104	,, .	Bradford, Lister Pk...	3·64	93	97
Cam.	Cambridge, Bot. Gdns.	1·87	47	80	,, .	Wetherby, Ribston H..	2·36	60	86
Essex	Chelmsford, County Lab	2·93	74	135	,, .	Hull, Pearson Park ...	1·80	46	62
,, .	Lexden, Hill House...	2·17	55	...	,, .	Holme-on-Spalding ...	2·93	74	...
Suff .	Hawkedon Rectory ...	3·17	81	122	,, .	West Witton, Ivy Ho..	3·15	80	...
,, .	Haughley House.....	2·67	68	...	,, .	Felixkirk, Mt. St. John	2·48	63	87
Norf.	Beccles, Geldeston....	2·81	71	130	,, .	Pickering, Hungate ...	3·88	99	...
,, .	Norwich, Eaton	2·36	60	100	,, .	Scarborough.....	4·02	102	145
,, .	Blakeney	2·73	69	121	,, .	Middlesbrough	3·14	80	115
,, .	Swaffham	2·69	68	104	,, .	Baldersdale, Hury Res.	2·93	74	83
Wilts.	Devizes, Highclere....	2·03	52	70	*Durh.*	Ushaw College	3·31	84	114
,, .	Bishops Cannings	2·90	74	94	*Nor .*	Newcastle, Town Moor.	2·37	60	81
Dor .	Evershot, Melbury Ho.	3·28	83	104	,, .	Bellingham, Highgreen	3·54	90	...
,, .	Weymouth, Westham..	...	...	...	,, .	Lilburn Tower Gdns...	2·12	54	...
,, .	Shaftesbury, Abbey Ho.	2·65	67	91	*Cumb*	Geltsdale.....	4·35	111	...
Devon	Plymouth, The Hoe...	4·35	111	146	,, .	Carlisle, Scaleby Hall .	2·78	71	68
,, .	Polapit Tamar	3·26	83	103	,, .	Seathwaite M.....	11·38	289	98
,, .	Ashburton, Druid Ho..	4·70	119	126	*Glam.*	Cardiff, Ely P. Stn.....	6·26	159	145
,, .	Cullompton	2·84	72	93	,, .	Treherbert, Tynywaun	7·89	200	...
,, .	Sidmouth, Sidmount ..	2·78	71	99	*Carm*	Carmarthen Friary....	4·81	122	104
,, .	Filleigh, Castle Hill ...	4·22	107	...	,, .	Llanwrda, Dolaucothy.	6·50	165	118
,, .	Barnstaple, N.Dev.Ath.	4·53	115	137	*Pemb*	Haverfordwest, School	4·40	112	...
Corn.	Redruth, Trewirgie ...	3·43	87	100	*Card.*	Gogerddan.....	6·58	167	135
,, .	Penzance, Morrab Gdn.	3·59	91	113	,, .	Cardigan, County Sch. .	2·72	69	...
,, .	St. Austell, Trevarna..	3·28	83	91	*Brec .*	Crickhowell, Talymaes	5·50	140	...
Soms	Chewton Mendip	4·38	111	98	*Rad .*	Birm. W. W. Tyrmynydd	4·92	125	91
,, .	Street, Hind Hayes ...	3·56	90	...	*Mont.*	Lake Vyrnwy	4·74	120	92
Glos..	Clifton College	2 86	73	82	*Denb.*	Llangynhafal	3·11	79	...
,, .	Cirencester	4 42	112	144	*Mer .*	Dolgelly, Bryntirion..	7 86	200	140
Here.	Ross, Birchlea.....	2·93	74	115	*Carn.*	Llandudno	1·76	45	58
,, .	Ledbury, Underdown.	2·22	56	85	,, .	Snowdon, L. Llydaw 9	16·43	417	...
Salop	Church Stretton.....	3·18	81	98	*Ang .*	Holyhead, Salt Island.	2·68	68	84
,, .	Shifnal, Hatton Grange	2 40	61	85	,, .	Lligwy	2·78	71	...
Staff.	Tean, The Heath Ho...	3·06	78	88	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	1·69	43	63		Douglas, Boro' Cem...	2·37	60	61
,, .	Blockley, Upton Wold.	2·51	64	85	*Guernsey*				
War.	Farnborough.....	1·73	44	63		St. Peter P't, Grange Rd	3·04	77	129

Rainfall: August, 1925: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	1·79	45	48	*Suth.*	Loch More, Achfary...	5·13	130	88
,, .	Pt. William, Monreith .	3·20	81	...	*Caith*	Wick	1·85	47	67
Kirk.	Carsphairn, Shiel.	4·70	119	...	*Ork .*	Pomona, Deerness	2·21	56	77
,, .	Dumfries, Cargen.....	6·53	166	149	*Shet .*	Lerwick	2·39	61	79
Dum	Drumlanrig	3·36	85	79					
Roxb	Branxholme	4·05	103	126	*Cork.*	Caheragh Rectory	3·92	100	...
Selk .	Ettrick Manse.....	5·66	144	...	,, ..	Dunmanway Rectory.	3·28	83	70
Berk.	Marchmont House	3·22	82	97	,, ..	Ballinacurra	4·03	102	108
Hadd	North Berwick Res....	2·29	58	72	,, ..	Glanmire, Lota Lo. ...	2·73	69	75
Midl	Edinburgh, Roy. Obs..	3·46	88	117	*Kerry*	Valencia Obsy.	3·81	97	80
Lan .	Biggar	2·62	67	79	,, .	Gearahameen	4·70	119	...
Ayr .	Kilmarnock, Agric. C..	3·51	89	90	,, .	Killarney Asylum.....	3·76	95	85
,, .	Girvan, Pinmore.....	3·00	76	67	,, .	Darrynane Abbey	4·04	103	93
Renf.	Glasgow, Queen's Pk..	3·48	88	98	*Wat .*	Waterford, Brook Lo..	4·54	115	119
,, .	Greenock, Prospect H..	4·25	108	78	*Tip .*	Nenagh, Cas. Lough...	1·77	45	45
Bute.	Rothesay, Ardencraig.	5·64	143	116	,, .	Tipperary	2·41	61	...
,, .	Dougarie Lodge	3·17	81	...	,, .	Cashel, Ballinamona ..	2·37	60	67
Arg .	Ardgour House	6·16	157	...	*Lim .*	Foynes, Coolnanes	1·82	46	47
,, .	Manse of Glenorchy..	5·25	133	...	,, .	Castleconnell Rec.	2·10	53	...
,, .	Oban	3·47	88	...	*Clare*	Inagh, Mount Callan ..	3·38	86	...
,, .	Poltalloch	4·03	102	82	,, .	Broadford, Hurdlest'n.	2·81	71	...
,, .	Inveraray Castle.....	5·85	149	89	*Wexf*	Newtownbarry	2·81	71	...
,, .	Islay, Eallabus.....	3·87	98	89	,, .	Gorey, Courtown Ho...	2·49	63	75
,, .	Mull, Benmore	9·40	239	...	*Kilk.*	Kilkenny Castle	1·83	47	53
Kinr.	Loch Leven Sluice	3·74	95	98	*Wic .*	Rathnew, Clonmannon	1·82	46	...
Perth	Loch Dhu	7·15	182	106	*Carl.*	Hacketstown Rectory .	2·89	73	71
,, ..	Balquhidder, Stronvar.	4·54	115	75	*QCo..*	Blandsfort House.....	1·93	49	49
,, ..	Crieff, Strathearn Hyd.	4·31	109	102	,,	Mountmellick	2·52	64	...
,, ..	Blair Castle Gardens ..	2·94	75	87	*KCo.*	Birr Castle.....	1·83	46	48
,, .	Coupar Angus School..	3·45	88	104	*Dubl.*	Dublin, FitzWm. Sq...	1·17	30	38
Forf.	Dundee, E. Necropolis.	1·81	46	55	,, .	Balbriggan, Ardgillan .	2·17	55	64
,, .	Pearsie House.....	3·73	95	...	*Me'th*	Drogheda, Mornington	2·82	72	...
,, .	Montrose, Sunnyside..	2·18	55	78	,, .	Kells, Headfort.....	2·41	61	58
Aber.	Braemar, Bank	2·07	53	62	*W.M*	Mullingar, Belvedere .	2·59	66	62
,, .	Logie Coldstone Sch. ..	1·30	33	41	*Long*	Castle Forbes Gdns....	1·77	45	43
,, .	Aberdeen, Cranford Ho	...	...	...	*Gal .*	Ballynahinch Castle ..	5·21	132	95
,, .	Fyvie Castle	·82	21	...	*Mayo*	Mallaranny.....	6·49	165	...
Mor .	Gordon Castle.....	1·60	41	50	,, .	Westport House.....	3·50	89	86
,,	Grantown-on-Spey....	1·28	33	40	,, .	Delphi Lodge	8·80	223	...
Na .	Nairn, Delnies.....	·98	25	41	*Sligo*	Markree Obsy.	3·65	93	85
Inv..	Ben Alder Lodge	2·67	68	...	*Cav'n*	Belturbet, Cloverhill..	2·22	56	60
,, .	Kingussie, The Birches	1·51	38	...	*Ferm*	Enniskillen, Portora ..	...	...	...
,, .	Loch Quoich, Loan....	5·50	140	...	*Arm.*	Armagh Obsy.	1·85	47	51
,, .	Glenquoich	4·57	116	56	*Down*	Warrenpoint	2·78	71	...
,, .	Inverness, Culduthel R.	·94	24	...	,, .	Seaforde	1·70	43	45
,, .	Arisaig, Faire-na-Squir	3·46	88	...	,, .	Donaghadee, C. Stn...	1·39	35	42
,, .	Fort William.....	4·38	111	71	,, .	Banbridge, Milltown .	2·03	52	58
,, .	Skye, Dunvegan.....	3·71	94	...	*Antr.*	Belfast, Cavehill Rd. .	2·13	54	...
,, .	Barra, Castlebay	1·47	37	...	,, .	Glenarm Castle.....	1·32	33	...
R&C	Alness, Ardross Cas. ..	1·51	38	51	,, .	Ballymena, Harryville	2·17	55	51
,, .	Ullapool.....	2·81	71	...	*Lon .*	Londonderry, Creggan	2·75	70	59
,, .	Torridon, Bendamph..	4·20	107	64	*Tyr .*	Donaghmore	2·45	62	...
,, .	Achnashellach	3·37	86	...	,, .	Omagh, Edenfel	...	...	...
,, .	Stornoway	3·16	80	80	*Don .*	Malin Head	3·01	77	86
Suth.	Lairg	1·16	29	...	,, .	Rathmullen.....	2·54	65	...
,, .	Tongue Manse.....	2·67	68	83	,, .	Dunfanaghy	4·48	114	102
,, .	Melvich School.....	2·32	59	78	,, .	Killybegs, Rockmount.	4·72	120	84

Climatological Table for the British Empire, March, 1925

STATIONS	PRESSURE		TEMPERATURE						Mean	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values											
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1021·9	+ 8·5	53	25	47·1	35·8	41·5	− 0·9	36·2	86	6·5	11	− 32	10	2·6	22
Gibraltar	1014·9	− 2·1	67	41	58·9	47·9	53·4	− 4·1	47·2	78	5·4	151	+ 29	10	...	...
Malta	1013·2	− 1·6	70	45	59·5	51·4	55·5	− 1·6	50·6	79	5·7	152	+114	11	5·7	48
Sierra Leone	1011·0	+ 0·1	93	71	90·2	73·0	81·6	− 1·1	74·7	68	3·4	4	− 24	1	...	...
Lagos, Nigeria	1007·6	− 1·8	93	70	89·1	77·4	83·3	+ 0·4	77·5	76	7·4	168	+ 72	10	...	...
Kaduna, Nigeria	1010·4	− 0·7	99	...	93·4	...	...	...	69·4	51	0·6	11	0	3	...	...
Zomba, Nyasaland	1008·4	− 1·8	87	63	81·0	64·4	72·7	+ 1·8	...	90	8·8	313	+ 84	22	...	...
Salisbury, Rhodesia	1008·3	− 2·3	81	54	76·7	59·9	68·3	+ 0·2	62·7	78	6·9	213	+106	18	5·9	48
Cape Town	1013·4	− 0·9	100	55	80·4	61·3	70·9	+ 2·5	61·6	72	3·1	1	− 21	1	...	...
Johannesburg	1012·4	− 1·5	79	46	71·8	54·3	63·1	− 0·2	57·3	87	7·8	156	+ 49	22	4·7	39
Mauritius	1013·8	+ 1·8	88	66	84·7	70·9	77·8	− 0·2	73·8	72	5·9	123	−115	21	7·7	63
Bloemfontein	...	...	82	49	75·7	53·6	64·7	− 2·7	60·9	81	5·6	146	+ 45	13	...	...
Calcutta, Alipore Obsy.	1009·2	− 0·7	103	57	93·3	69·4	81·3	+ 1·2	69·7	82	3·2	12	− 25	*1	...	...
Bombay	1009·5	− 1·4	95	67	89·1	74·4	81·7	+ 2·2	71·7	70	2·1	0	− 1	*0	...	...
Madras	1010·0	− 0·9	93	67	88·3	71·9	80·1	− 1·0	75·1	81	4·2	73	+ 68	*2	...	...
Colombo, Ceylon	1009·2	− 1·2	92	71	87·2	73·7	80·5	− 0·8	76·4	71	6·6	186	+ 71	15	6·4	53
Hong Kong	1014·9	− 1·2	79	55	67·7	60·6	64·1	+ 0·8	60·0	80	7·4	210	+139	13	3·7	31
Sandakan	...	...	88	73	84·4	74·3	79·3	− 1·8	75·7	83	...	290	+ 84	21	...	...
Sydney	1016·9	+ 0·7	82	51	74·9	61·2	68·1	− 1·2	63·9	72	7·5	77	− 49	15	5·9	48
Melbourne	1017·4	+ 0·4	91	43	73·8	54·4	64·1	− 0·4	57·0	64	6·8	16	− 41	7	6·6	53
Adelaide	1016·6	− 0·4	97	47	82·1	58·9	70·5	+ 0·6	58·4	43	3·6	10	− 16	3	8·9	73
Perth, W. Australia	1014·1	− 1·2	94	54	80·1	62·4	71·3	+ 0·2	63·9	64	5·0	30	+ 11	7	7·3	59
Coolgardie	1013·6	− 1·2	99	50	81·8	60·9	71·3	− 0·4	60·3	59	5·6	24	+ 5	5	...	...
Brisbane	1013·3	− 1·1	95	61	78·8	70·6	74·7	+ 0·4	66·9	73	6·7	235	+ 87	18	4·3	35
Hobart, Tasmania	1015·5	+ 1·5	83	42	66·5	49·8	58·1	− 1·3	51·6	67	6·0	58	+ 15	9	6·9	56
Wellington, N.Z.	1016·0	− 1·0	75	41	67·3	53·2	60·3	− 0·1	55·6	65	5·5	53	− 30	5	6·7	54
Suva, Fiji	1006·7	− 1·8	90	71	87·5	73·4	80·5	+ 0·4	75·9	80	6·5	163	−210	20	...	...
Apia, Samoa	1009·4	+ 0·2	88	73	84·0	74·7	79·3	0·0	76·8	79	6·5	331	− 13	25	5·1	42
Kingston, Jamaica	1014·4	− 0·5	90	63	85·9	65·9	75·9	− 1·2	65·0	81	3·2	25	− 1	5	...	...
Grenada, W.I.	1013·1	+ 0·2	88	69	83·6	71·5	77·5	− 0·2	71·9	70	5·2	57	− 13	14	...	...
Toronto	1017·5	+ 0·5	62	1	42·0	27·7	34·9	+ 6·0	29·4	72	6·0	73	+ 6	13	4·4	37
Winnipeg	1018·0	− 0·8	55	−25	29·3	10·8	20·1	+ 5·7	...	...	5·6	50	+ 23	9	4·4	37
St. John, N.B.	1018·3	+ 4·1	62	9	40·8	26·8	33·8	+ 5·4	29·2	79	6·7	123	+ 8	16	4·7	39
Victoria, B.C.	1018·8	+ 3·0	55	35	50·0	39·5	44·7	+ 1·5	39·1	85	6·3	51	− 14	14	4·8	41

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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Hugo Hildebrand Hildebrandsson*

Professor Hildebrandsson, who died at Upsala on July 29th at the advanced age of 87, occupied during his official career an exceptional position in the meteorological world. He was professor of meteorology in the University of Upsala and head of the Meteorological Institute, which included an observatory but had no network of stations in the ordinary sense. Born at Stockholm on August 19th, 1838, he graduated in philosophy at Upsala in 1866, became assistant to A. J. Ångström, was lecturer on physics, then lecturer in meteorology and chief of the meteorological section of the observatory. He organised observations of the motion of cirrus clouds in Sweden, which soon extended to the whole of Europe, and, in 1896, to the whole globe. Meanwhile he was invited to a newly established professorship of meteorology with an institute which was independent of the Swedish meteorological service, and this gave him academic freedom and perhaps a bias towards world meteorology.

Hildebrandsson was especially fortunate also in his friendship and association with Léon Teisserenc de Bort, cadet of a wealthy French family, an enthusiastic meteorologist who had an observatory on land and, in conjunction with A. L. Rotch, a floating observatory at sea. This was the steam yacht "Otaria," transformed from a "fish carrier." The great but unfinished

* Abridged from a biographical notice by Sir Napier Shaw which is to be published in full elsewhere.

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work, *Les Bases de la Météorologie dynamique ; Historique, État de nos connaissances,* is an abiding memorial of this collaboration between Hildebrandsson and Teisserenc de Bort : it is a magnificent work which is altogether beyond the range of the ordinary meteorologist's ambition. Hildebrandsson's view of meteorology was essentially dynamic, the investigation of physical processes in the atmosphere, but in no limited manner ; the whole length, breadth and thickness of the atmosphere were included in the study, which was enriched by several original contributions from Teisserenc de Bort to the meteorology of the upper air. Hildebrandsson's work on clouds gave us the International Cloud Atlas ; next best-known is his work on centres of action in the atmosphere, five papers in the transactions of the Swedish Academy illustrated by tables and curves which suggest correlation coefficients. There is not much in Hildebrandsson's work which we ordinarily understand as theory ; he was disposed rather to observe the motion of the atmosphere and deduce therefrom the forces that are operating rather than to formulate the forces *a priori* and thence deduce a motion which may or may not be atmospheric.

Hildebrandsson was a very companionable man with a good deal of humour as well as dignity. He was associated for many years with the International Meteorological Organization, becoming a member of the Committee in 1891 and secretary from 1900 until he retired from his professorship in 1907. He received many honours, including the Symons Medal of the Royal Meteorological Society and the embroidered Velvet collar of the Swedish Academy of Sciences ; he was Knight of the Order of the North Star, Commander of the Order of Vasa and of the Danish Dannebrog, and officer of the Legion of Honour. After his retirement he continued his researches and his last communication was issued less than two years ago.

British Association for the Advancement of Science

Southampton Meeting, Aug. 26th to Sept. 2nd, 1925.

THE Meeting of the British Association for the Advancement of Science at Southampton this year, was one in which meteorology played more than its normal part, not so much in respect of the actual number of papers contributed in the sections, as in respect of the attention devoted to the subject by workers in other fields, in particular that of general physics. The principal reason for this was to be found, of course, in the fact that the Presidential

Chair of the Mathematical and Physical Section (Section A) was occupied by Dr. G. C. Simpson, F.R.S., Director of the Meteorological Office.

Dr. Simpson in his Presidential Address dealt with " The New Ideas in Meteorology," and general appreciation was expressed of his very clear exposition of the manner in which the modern meteorologist views the atmosphere and its structure and motion.

Dr. Simpson divided his address into four parts, each of them dealing with principles which, although not exactly new, had been appreciated even by meteorologists only in the last few years.

Dealing first with *Thermal Stratification of the Atmosphere*, he said that our knowledge of the temperature of the free air dated only from 1898, when Teisserenc de Bort introduced his *ballons sondes*. Since then observations had been made in all meteorologically important areas of the globe. The atmosphere, which itself is comparatively speaking an extremely thin film of air, is composed of two shells surrounding the earth, the troposphere below and the stratosphere above, with the extremely sharp surface of separation—the tropopause—between them. After a brief description of the distribution of temperature in the atmosphere, Dr. Simpson went on to discuss the question of entropy. Any mass of air retains its initial entropy, no matter what its position in the atmosphere is, unless heat is added or extracted by processes such as condensation or radiation, so that the air must always travel along a surface of equal entropy. These isentropic surfaces or strata therefore act like physical restraints to the air preventing vertical motion. It is only when this stratification is less pronounced, a condition which occurs when the lapse rate is great, that ascending currents take place and then generally with considerable violence.

Coming next to *Mechanism of the Atmospheric Heat Engine*, Dr. Simpson dealt with the problem of how the kinetic energy of the winds is derived from the solar radiation which falls on the earth. He pointed out that the essential difference between the old idea and the new one due to Margules, is that the two masses of air whose difference of temperature is the cause of the motion, never mix. In each mass there is different stratification of isentropic surfaces so that when the two masses are brought side by side the cold mass slowly pushes its way as a wedge under the warm air and its isentropic layers are lowered. Similarly the isentropic layers in the warm air are raised, but the surface of discontinuity between them, which may be likened to a geological fault, is a sliding surface, and no air crosses it. The energy of the winds is derived mainly from the readjustment of the centre of gravity of the air mass considered as a whole, although the latent heat of condensation provides some additional energy by supplying heat to the warmer air as it ascends the slope of the surface of discontinuity.

These *Surfaces of Discontinuity* would soon disappear on a stationary earth, but mathematical investigations of the conditions governing the air motion at surfaces of discontinuity, chiefly carried out by Helmholtz, Margules, V. Bjerknes, and Exner, have shown that on a rotating earth inclined surfaces of discontinuity could be found persisting sometimes for days, sometimes permanently. The angle which the surface makes with the horizontal depends on three factors, the latitude, difference in temperature, and relative motion of the warm and cold currents. According to Bjerknes, there are three permanent surfaces of discontinuity : 1. Between the troposphere and the stratosphere. 2. Between the trade and anti-trade winds. 3. The polar front. Besides these three there are now recognised a constant succession of temporary surfaces of discontinuity which form and pass away in our own latitudes. This was followed by a short summary of the recent investigations of these surfaces, especially by J. Bjerknes, Bergeron and Stüve.

Finally, Dr. Simpson discussed the *Origin and Structure of Cyclones*, commencing with a comparison between the old idea of a cyclone as a nearly symmetrical vortex and the complex structure of a cyclone as depicted by Bjerknes, who interprets cyclones as gigantic waves or breakers on the polar front. More and more are we being forced to recognise in cyclonic depressions the meeting place of polar and equatorial air, but the forces which bring these two masses of air into juxtaposition are still far from clear. Moreover, it has not yet been shown that the forces brought into play are of the right order of magnitude. In a rival theory, Exner considers that the cold air moving westwards in polar regions is deflected southward by Greenland and other land masses, forming tongues of cold air which act as barriers to the warm westerlies ; cyclones are formed in the lea of these barriers. There is probably some truth in both these theories, but both fail to the extent that they make cyclones phenomena of the lower atmosphere while we have good reason to believe that the stratosphere plays a large part in their formation. These new ideas of the mechanism of a cyclone have had a far-reaching effect on the practical applications of meteorology, but the problems awaiting solution are numerous and difficult, and Dr. Simpson appealed to the Universities for help in solving them.

It was a matter of general regret that, owing to circumstances arising just before the meeting, Sir Napier Shaw, F.R.S., was unable to be present. His important paper, on "Trigger Action in the Atmosphere," was read by one of the Secretaries of Section A, and an abridged account of the author's abstract follows :—

" In discussions of the transformations of energy in the atmosphere it is sometimes suggested in explanation of certain kinds of rainfall that there may be something in the atmosphere analogous to catalytic action by which the transformation is initiated and continued, although the energy which is transformed is not supplied by the initiating agent, but is derived from the interaction of the constituent parts of the rest of the atmosphere. One of the characteristic features of such a condition is the discontinuity between two states which differ only in the presence or absence of the ' catalyser ' or initiating agent.

" Assuming that the condensation of water-vapour to form rain is a consequence of the reduction of pressure, we recognise at the outset that the transformation of energy associated with rain is twofold in character. There is first the gravitational energy of the environment which forces some portion of the air to rise, and secondly there is the development, in the form of sensible heat during elevation, of what was originally latent in the vapour. The energy of the second kind operates to limit the reduction of temperature, by reduced pressure, to an amount much below that which would be consequent upon the same reduction of pressure if the air were dry, and thereby to maintain or even increase the amount of energy available in the environment for further automatic elevation.

" The development of ancillary energy in the environment in this way may be so great as to place the originally saturated air in a condition which, without unfairness, may be described as explosive ; and it is on that account that the name ' trigger action ' may be applied to it. The ancillary energy comes from the saturated air itself and the supply is limited by the amount of saturated air available. In a sense therefore the process is not exactly catalytic.

" The communication draws attention to the parts which are taken by the environment and the environed air respectively, in this explosive action, and illustrates the subject by examples derived from the exploration of the pressure, temperature and humidity of the air by sounding balloons, kites or aeroplanes. For this purpose the results of soundings are set out in certain new kinds of diagrams which, for the sake of reference, are called

'tephigrams' and 'depegrams.' A tephigram, like an indicator diagram, shows the properties of the environing air in a vertical section of the atmosphere referred to (t) temperature and (ϕ) entropy as co-ordinates, with a background exhibiting the physical properties of saturated air; and a depegram shows the properties of the air in the same vertical section referred to the temperature of its dewpoint (d) and its pressure (p)."

Sir Gilbert Walker, F.R.S., presented a paper on "Seasonal Variations of Weather in the North Atlantic," which he summarised in the following terms:—

"Of the three well-established oscillations—that in the southern oceans, that in the N. Pacific, and that in the N. Atlantic—the last is largely independent of the other two. Many facts regarding it have been established, of which a summary is given in the paper, and the controlling factor appears to be the pressure distribution rather than the sea temperature; but the causes of the pressure variation are mostly still unknown. Hildebrandsson's theory that the conditions are controlled by the quantity of ice seems to present considerable difficulties."

In a paper on "Periodicities in the Weather," Mr. D. Brunt described recent work which is likely to have far-reaching consequences. In his own words:—

"The paper gives a discussion of the results derived from a periodogram analysis of twelve sets of meteorological data each extending over at least 100 years. The data used are temperature at London, Edinburgh, Paris, Berlin, Vienna, and Stockholm; rainfall at London, Edinburgh, Milan, and Padua; and pressure at Edinburgh and Paris. The periodograms are given in detail in a paper read at the Royal Society in June 1925.

"It is found that no periods over 10 years in length are common to all the records, but some short periods, of lengths between 13 and 60 months, occur in a number of temperature records, with sensibly the same phase. An 11-year period, which may be the sunspot period, occurs in the Edinburgh temperatures, but in none of the other records; though a period of between 22 and 23 years, which may be the double sunspot period, occurs in several of the records.

"It is considered improbable that these results can be utilised for forecasting the weather at any future time."

Among the other papers read in Section A, may be mentioned Mr. N. K. Johnson's paper on "A Study of the Vertical Gradient of Temperature in the Atmosphere near the Ground"; Professor Proudman's paper on "The Effects of Capes, Bays and Islands on Local Tides"; and Dr. A. T. Doodson's paper on "Tide-predicting Machines." There was also Sir Frank Dyson's contribution, "Fixing the Position of the Equator"; Professor W. F. G. Swann's paper, "An Attempt to detect Corpuscular Radiation of Cosmic Origin"; and Mr. W. J. Thorrowgood's paper, "Earth Currents due to Magnetic Storms." Dr. R. L. Smith-Rose read a paper on "The Study of Wireless Wave Fronts by Directional Methods," which had some points of contact with geophysics. Geology joined with physics in a discussion on "Variation in Gravitational Force and Direction, and its relation to Geological History."

There were a number of papers in other sections of the Association of interest to meteorologists as such, the one of most direct concern being a contribution by Professor W. M. Hobbs to

the programme of Section E (Geography), under the title, "The Source of the Cold Air of the North Polar Front." Professor Hobbs's contention is that Greenland is the main source of the cold air, a line of thought long since associated in this country with the name of Sir Napier Shaw. A glance through the daily time table revealed other papers with a meteorological bearing, including "Climate and Migrations in the Neolithic Age in Britain," by Mr. O. G. S. Crawford, before Section H (Anthropology); and "The Influence of Weather Conditions on the Growth in Diameter of Trees," by Mr. T. Thomson, before Sub-Section K (Forestry).

It is customary at meetings of the British Association to arrange a number of "Citizens' Lectures," at which members of the Association as such are not present. Residents in Southampton had the privilege of hearing Mr. C. J. P. Cave on the subject "The Highway of the Air," a lecture which he also delivered on another evening to the Citizens of Salisbury. Another Citizens' Lecture, that by Professor E. V. Appleton, was of geophysical interest. His subject was "The Rôle of the Atmosphere in Wireless Telegraphy."

Reports were presented by the Committees for the Investigation of the Upper Atmosphere, and for Seismological Investigations, both showing very healthy activity during the past year. Both committees asked for reappointment, and it is noted that the former intends to devote special attention to the very important subject of radiation.

On the lighter side may be mentioned an official excursion to the Royal Air Force Base at Calshot, by permission of the Air Ministry. Here demonstration flights by flying boats were given, and parties were conducted round the station, including a visit to the meteorological station. Afterwards an excellent tea was provided, and the whole party journeyed back to Southampton by boat in the way it had come, having spent a very enjoyable afternoon in very good weather conditions.

The Meteorological Luncheon was held again as in past years, and was a very successful function, bringing together in all 47 meteorologists and their friends. It was held at the South Western Hotel, and those present included:—

Dr. G. C. Simpson, F.R.S., President of Section A (in the Chair); Professor H. Lamb, F.R.S., President of the Association; Sir Frank Dyson, F.R.S., Astronomer Royal; Professor H. H. Turner, F.R.S., Mrs. and Miss Turner; Sir Gilbert Walker, F.R.S.; Mr. C. J. P. Cave, President of the Royal Meteorological Society, and Mrs. Cave; Professor J. W. Nicholson, F.R.S., and Mrs. D. Wrinch-Nicholson; Mr. F. E. Smith, F.R.S., General Secretary of the Association; Dr. Harold Jeffreys, F.R.S.; Dr. Vaughan Cornish; Professor W. G. W. Swann; Professor A. M. Tyndall, Recorder of Section A; Professor E. H. Neville, Mr. W. M. H. Greaves and Mr. M. A. Giblett, Secretaries of Section A; Professor H. Stansfield, Local Secretary of Section A; Dr. J. S. Owens and Mrs. Owens; Mr. D.

Brunt; Mr. N. K. Johnson; Miss E. E. Austin; Captain J. Durward; Professor E. L. Watkin; Mr. W. Parnell Smith; Mr. R. Casson; Miss A. M. Trout; Mr. J. J. Shaw; Mr. F. J. W. Whipple; Mr. R. S. Whipple; Mr. R. A. Fisher; Professor T. H. Havelock; Mr. W. Hall; Dr. H. Borns; Mr. P. Y. Alexander; Mr. O. G. S. Crawford; Mr. G. Merton and Mrs. Merton; Mr. W. C. Parkinson; Mr. H. Carroll; Mr. A. P. Jenkin; Mr. W. G. W. Mitchell; Mr. E. W. Bliss; Mr. J. S. Farquharson.

The Meteorological Office, Air Ministry, by request of the Council of the Association, and with the collaboration of the Signals Branch of the Air Ministry, again gave a demonstration of weather forecasting from broadcast data received locally by wireless. The demonstration was given in a room in King Edward VI. Grammar School, adjacent to the Reception Room, and in the same room there was a comprehensive display of meteorological instruments, diagrams and photographs. A " Local Daily Weather Report " was produced and copies posted each day in the various sectional meeting rooms. As was done on a previous occasion, at Hull, the morning's weather chart and forecast were reproduced on the back of the menu at the Meteorological Luncheon. The exhibit was very well attended indeed, the item which attracted perhaps the most attention being a wonderful set of stereoscopic cloud photographs taken from an aeroplane and presented to the Meteorological Office by Commandant J. Jaumotte, Director of the Belgian Meteorological Institute.

OFFICIAL NOTICES

Discussions at the Meteorological Office

THE series of meetings for the discussion of recent contributions to meteorological literature, especially in foreign and colonial journals, will be resumed at the Meteorological Office during the session 1925-26. The meetings are being held on alternate Mondays at 5 p.m. The subject arranged for the first meeting, which was on Monday, October 12th, was a paper by A. Defant, entitled *Die Schwankungen der atmosphärischen Zirkulation über dem Nordatlantischen Ozean im 25-jährigen Zeitraum* 1881-1905 (Geog. Ann. Stockholm VI 1924, p. 13). The discussion was opened by Mr. R. G. K. Lempfert, M.A.

The subjects for discussions for the next meetings will be :—

October 26th, 1925. *Die atmosphärischen Elektrizität über den Meeren.* By K. Kähler (Ann. Hydr., Bd. 52, p. 201). *Opener*—Mr. R. E. Watson, B.Sc.

November 9th, 1925. *The light of the night sky, its intensity variations when analysed by colour filters.* By Lord Rayleigh (London Proc. R. Soc. A. 106, 1924, p. 117). *Opener*—Dr. G. M. B. Dobson.

The dates for subsequent meetings are as follows :—

November 23rd; December 7th, 1925. January 18th; February 1st and 15th; March 1st and 15th, 1926.

The Director of the Meteorological Office wishes it to be known that visitors are welcomed at these meetings.

Crop-Weather Stations

ABOUT a year ago a scheme was instituted by the Ministry of Agriculture and Fisheries and the Board of Agriculture for Scotland acting in co-operation with the Meteorological Office. In connection with this scheme, two meteorological courses were held at Kew Observatory from September 28th to October 1st. The first course was for the benefit of those who had little previous experience of the work of a meteorological observer, the other course was arranged primarily for those who were more advanced. Observers from eleven stations attended the first course, and those from nineteen stations the second course. Three members of the staff of the Ministry of Agriculture and Fisheries were present.

These courses were followed by a Conference at the Meteorological Office in connection with the same scheme, at which Sir Napier Shaw took the Chair. Dr. B. A. Keen, Assistant Director of the Rothamsted Experimental Station, read a paper on "Agricultural meteorological work at Rothamsted, with special reference to Soil, Temperature and Drainage," and Mr. W. R. Black, Secretary of the Agricultural Meteorological Scheme, on "The Soil Evaporation Apparatus at Bangor." Other papers read at the Conference were: "Effect of Meteorological conditions on Plant Diseases," by Dr. E. J. Butler, of the Imperial Bureau of Mycology, Kew; "Wind records and windmill investigations at Harpenden," by Mr. C. A. C. Brown, of the Institute of Agricultural Engineering, Oxford; "Effect of length of Day on Plant Growth," by Mr. M. A. H. Tincker, of the Welsh Plant Breeding Station, Aberystwyth; and "Effect of Weather on Crops at Aberystwyth," by Mr. M. G. Jones, of the same station.

OFFICIAL PUBLICATION

The following publication has recently been issued :—

A Barometer Manual for the Use of Seamen. A text book of Marine Meteorology with an Introduction and Appendices (M.O. 61), Tenth edition.

Very few changes have been made in this edition.

Correspondence

To the Editor, *The Meteorological Magazine*

Totland Bay Rainfall

THE total rainfall for the 8 months, January-August, 1925, amounts to 24·15 in. During my 38 years of readings at Totland Bay this is the first time I have registered so great a rainfall for this period of the year. The nearest approach to it is 22·92 in. during the similar period in 1912. The average rainfall for these 8 months is 16·53 in. It has taken 4½ years to make up for the deficit of the 1921 great drought, which began with February of that year, as the following table will show :—

	Rainfall 1921-5.	Average Rainfall.
	in.	in.
February-December, 1921 ..	11·49	26·38
January-December, 1922 ..	29·84	28·95
January-December, 1923 ..	30·73	28·95
January-December, 1924 ..	35·22	28·95
January-July, 1925 ..	19·29	14·08
August, 1925	4·85	2·45
Total ..	131·42	129·76

JOHN DOVER.

Aston House, Totland Bay, Isle of Wight. September 4th, 1925.

Extent of a Flash of Lightning

THE extent over which the force of a flash of lightning can be felt is a question which I do not remember to have seen discussed in the *Meteorological Magazine*. On Monday, August 10th, several thunderstorms passed over the north of Cornwall. I was away from home on that day and experienced a heavy thunderstorm at Wadebridge about the middle of the day, and a slighter one at Polzeath on the sea-coast not far from Padstow about 4 p.m. (summer time). On my return home to Bolventor on the edge of the Bodmin Moors in the evening, I was informed of a heavy thunderstorm which had occurred about 5.30 p.m. (summer time) in which one flash of lightning had struck the earth. Careful enquiry showed that a flash of lightning followed by a terrific peal of thunder had struck the ground in a marshy spot possibly about 200 yards north of the Vicarage. A hole was made in the ground the depth of which could not be exactly ascertained owing to the wet nature of the ground, and the grass was torn up and turned over as if by a spade. The tenant of the farm which is about 150 yards west from the spot saw what appeared to him to be smoke rising from the ground where the lightning struck. He himself received a shock, the effects

of which he felt at the back of his neck for a few hours afterwards. His daughter, who was close by in the cowhouse, came rushing out in great fear saying that she had received a blow on her legs. The lightning also struck another farmhouse situated about 250 yards north of the marsh, doing a little damage in breaking glass and tearing the plaster off the wall. The tenant, a young man, who was working in the yard was thrown over the wheelbarrow by his side. Careful enquiry leaves no doubt in my mind that all that I have described above was the result of the same flash of lightning, for the young man who was thrown over the barrow came running down within a few minutes to relate his experience to the other farmer, and both agree that in the storm there was no other flash of lightning which was near enough to cause damage. Perhaps others who have experienced severe thunderstorms may be able to give some information on this question of the extent over which the force of a flash of lightning can be felt.

ARTHUR S. RASHLEIGH.

Bolventor Vicarage, Launceston, Cornwall. August 29th, 1925.

Frequency of Mammato-Cumulus Cloud

DURING the years 1903-1910 mammato-cumulus cloud was recorded at Epsom, Surrey, on 68 days, and from 1918-1924, in London, on 59 days.

The two periods thus give an annual average frequency of 8·5 and 8·4 days respectively. During 1918 the cloud was seen on only 2 days during the year, and in 1907 and 1924 on 14 days. The monthly frequency distribution was as follows:—

Date.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1903-10 ..	1	4	4	7	8	8	12	12	7	2	2	1
1918-24 ..	0	0	1	5	9	9	16	9	3	2	3	2

From the point of view of distribution in time the hour of maximum frequency occurs at 15h., but there is a morning maximum at 11h., and another in the evening at 18h., these hours being common to both periods. The cloud was seen as early as 5h. 45m. on April 21st, 1923, and as late as 21h. on July 29th, 1903. On May 19th, 1923, it formed on three separate occasions during the day. From 1903-1910 rain fell at some period of the day in 81 per cent. of the cases of appearance of the cloud, thunderstorms occurred in 31 per cent. From 1918-1924 the figures for rain were 83 per cent. and for thunderstorms 27 per cent.

SPENCER RUSSELL.

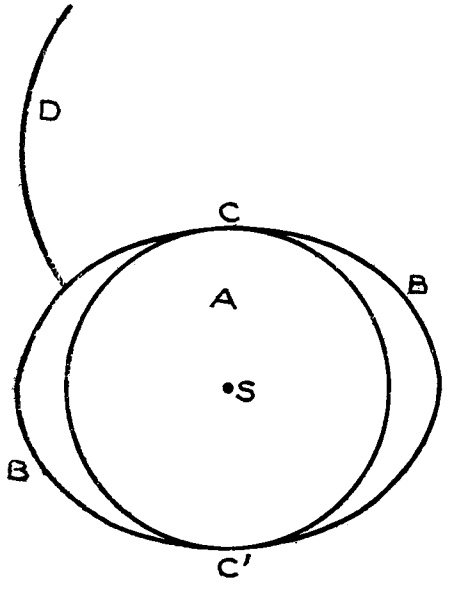
September 25th, 1925.

NOTES AND QUERIES

Notable Cloud Formations

Mr. Henry A. Rogers reports that at Bristol, on July 15th, at 4h. 30m., he saw a notable example of an eddy cloud, a long line nearly straight stretching from west to east horizon with front curled and with rear of stratus character. There was also a similar cloud but not so lengthy parallel to it. It drifted to the south-east, the sky in front being quite clear until sunset when the cloud developed into lenticular stratus. Mr. Rogers adds that on July 7th, 1922, he saw at Hastings the Noah's Ark cloud formation so much dreaded by the Orkney fishermen, a long line of cloud from south-east to north-west, the shape, of boat formation, pointed front and rear and full at the wide centre and throughout with cumulus, stratus and cirrus all curled and mixed. He was thus able to warn the Lifeboat people and the fishermen of the approach of one of the worst storms experienced in the English Channel in a July.*

Remarkable Halo at Guernsey, July 3rd, 1925



THE subjoined sketch illustrates a fine halo observed at L'Ancresse Bay, Guernsey, on July 3rd, 1925, from 10h. 30m. to 11h. G.M.T. S represents the sun. A was a dark circle representing the halo of 22°, B was an elliptical light arc; where it met A at C and C' a vivid spectrum was noticed, the violet band being on the side towards the sun. D represents a portion of a larger arc, apparently with a radius of 90°; at its upper end this was lost in cirrus cloud and it was not visible within the halo.

The occurrence was recorded in the local press, with comments on its beauty and striking appearance, but without any attempt at exact description.

C. E. P. BROOKS.

* See Meteorological Magazine, 57 (1922), 196.

The Soaring Flight of the Albatross

IT is well known that many birds are capable of remaining in the air for long periods without flapping their wings, or making any other obvious muscular effort. This soaring flight has been attributed to the support offered by rising currents of air. Such rising currents are formed where a horizontal wind strikes an obstacle such as a line of cliffs and is forced upwards, and it is especially near high cliffs with an onshore wind that soaring flight of this type can best be seen. In hot countries, as described by Dr. E. H. Hankin, birds are able to make use of the much weaker thermal ascending currents. Neither of these sources of support are available over the open sea, however, and yet birds such as the albatross are capable of soaring flight far from land. This problem has been investigated by M. Idrac* who made a voyage to South Georgia for the purpose. It had been suggested that the birds could make use of rising currents formed where the wind was blowing against waves which were moving with a different speed, but M. Idrac found that this explanation was not tenable, since soaring flight could take place with waves less than a foot high; moreover the points selected by the birds for the beginning of their ascending flight, were not on the windward sides of the waves, but on the leeward, where the wind velocity was least.

The secret was revealed by means of studies with a moving-picture camera—the birds make use of variations in the speed of the wind. We may employ the analogy of a kite, which is supported by the upward thrust of a horizontal air current striking against the under surface of the material. The kite is held in position by a cord; to make the kite rise higher, one holds the cord and runs against the wind. One could also maintain the kite by running with the wind, but faster than the wind is blowing. The albatross has no cord, and hence is blown along by the wind and in a uniform wind current it could not soar. If the wind increases it takes a few seconds for any body floating in the air to take up the new wind velocity, and during those few seconds the albatross can use its extended wings as a kite and soar upwards a few feet. Similarly, when the wind decreases, the albatross is for a few seconds travelling faster than the wind, and can again find support.

Over the sea with a steady wind, the variations of velocity at the same level are not often sufficiently great or regular for soaring flight, but a variation of a different nature is almost invariably present. Owing to friction, the speed of the air is relatively small just above the surface of the sea, and increases up to a height of thirty to fifty feet—a well-known fact.

* *La Nature*, Paris, 53 (1), 1925, p. 241.

Hence the albatross can always find a variation of wind velocity by changing its level. The procedure is roughly as follows; the bird is moving rapidly near the surface of the sea and therefore in a layer of low wind velocity. It turns head on to the wind, with its wings at an angle of about 55 degrees with the horizontal and the upward thrust of the wind raises it several feet. By the time the resistance of the air has reduced the bird's velocity to such an extent that the lowest air layer could no longer provide sufficient support, the bird has reached a higher layer and is therefore still moving fast enough into the wind to rise still further. In this way, always keeping head on to the wind, it rises to a height of thirty or forty feet. The change of velocity with height is now too small for it to soar higher, consequently it turns its back to the wind and begins to descend. Moving from a layer of greater to one of lesser wind speed, it is now overtaking the air, and can derive sufficient support during its descent for gravity to give it speed enough at the bottom of the curve to repeat the manœuvre. The whole operation takes about ten seconds and the albatross is in fact creating a series of artificial gusts of this period relative to itself sufficient to sustain it in the air without flapping.

Human gliding flight has hitherto made use only of ascending currents caused by obstacles in the course of the wind. The author considers that it may be possible to make use of thermal ascending currents, but he thinks that it is not practicable for human gliders to utilise the variation of wind velocity with height in the manner of the albatross, because the variation is rapid enough only in the lowest thirty or forty feet, and this does not provide sufficient space for manœuvring.

Trajectories of Upper Air Currents

DURING the summer of 1922 toy balloon " races " were arranged at Brighton by Major MacLulish, and prizes were awarded for long distance flights. At the suggestion of Mr. Hy. Harries, the date and time of release were inserted on the post cards carried by the balloons in the hope that interesting information might result from a study of the falling places of the balloons. Mr. Harries discusses some of the results in the *Meteorological Magazine* for March, 1923. The most interesting case was that of September 13th, 1922, when a depression was advancing south-east across the British Isles, " while 15 balloons were drawn into the cyclonic whirl, 5 were carried outside into north-eastern France."

From December, 1922, postcards were attached to the pilot balloons which are released daily at many meteorological stations

in this country and the results obtained during 1923 are discussed in *Professional Notes*, No. 42, which will be issued shortly.

The results obtained were rendered somewhat uncertain by reason of the fact that the balloons did not necessarily travel at any given height for any length of time, and it was suggested that if balloons could be made to drift along at a certain height useful information respecting the history of upper air currents might be obtained.

The following method of attacking the problem has been tried at Sealand, Chester. Two balloons are used; the first is inflated so that it just supports the weight of the second balloon uninflated, plus a length of connecting thread. The second balloon is then inflated until the whole system has the desired rate of ascent. The second balloon is burst when a certain height is reached and the first balloon then floats along at this height supporting the remains of the other. With regard to the methods of bursting the second balloon; over-inflation has been tried but is too uncertain; time fuses are somewhat uncertain and introduce a slight element of danger. The method which has been most successful is that in which a sharp point punctures the balloon at a definite amount of expansion which can be calculated with reasonable accuracy. The balloons carry post-cards and 10 of these have been returned. In 6 cases the bursting height of balloon No. 2 was observed; in the 4 other cases, the bursting height can only be given approximately.

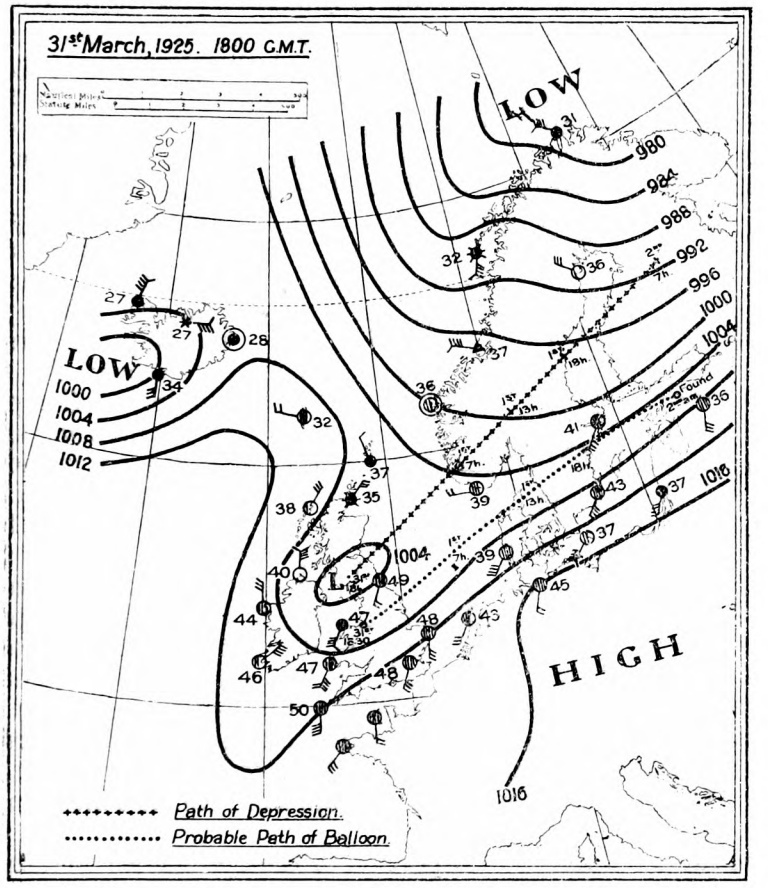
The first thing that strikes one is that the length of the flight and the duration of the flight have not been materially increased. With one exception, the times of flight are rather short—some definite ones being 55 min., 4¼ hours, 5 hours, 5-6 hours, 7 hours, 8 hours, or about the same as is obtained generally by the use of one balloon. Apparently the leakage from the unburst balloon is sufficient to bring the whole system to earth in 5-6 hours.

Little can therefore be gained from a study of the above. In two high ascents, the resultant displacement is in accordance with the motion of the high cloud; in the lower ascents the surface pressure distribution is sufficient to trace the trajectory of the balloon with reasonable accuracy. In one or two cases, however, it would appear that the first balloon rose well above the "bursting height" of No. 2. In one case the bursting height is given as 100 feet but the height at which the balloon subsequently travelled seems to have been about 6,000 feet. This occurred in a showery or rainy westerly type of weather when a good deal of upward movement would be anticipated. It is thus unsafe to neglect the vertical component and treat the problem as a two dimensional one.

A Long Flight. Balloons were released at Chester at 16h. 30m.

on March 31st, 1925, and were found on April 2nd, 1925, in Estonia, a run of about 1,220 miles. This is the longest distance which a pilot balloon has been known to accomplish and implies a time of flight of 35-40 hours.

The synoptic chart for 18h. on March 31st, 1925, is reproduced herewith. The " crossed " line shows the path of the depression which travelled at an average speed of 38 m.p.h. ; the dotted

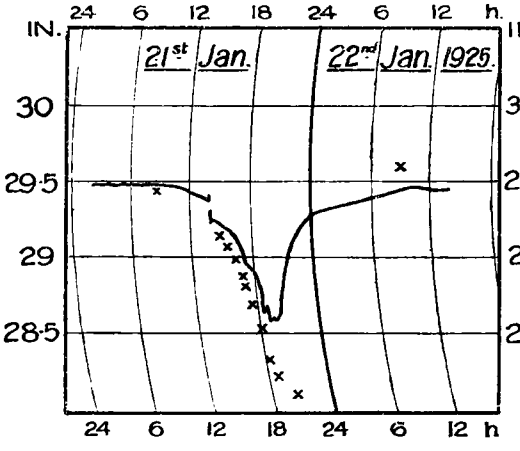


line indicates the probable path of the balloon. The speed with which the latter travelled has been reckoned about 32 m.p.h., but this may be rather low in view of the uncertainty of the wind velocity under rather rapidly changing pressure gradients. But the manner in which depression and balloon travelled in the direction and with the speed demanded by the isobars on the south side of the low (1,008 and 1,012 mb. isobars on 18h. chart) is rather striking.

J. DURWARD.

Tropical Cyclone in Western Australia, January 21st, 1925

AN interesting record of pressure changes during the passage of a tropical cyclone on January 21st, 1925, was secured at Roebourne, on the north-west coast of Western Australia. A definite cyclonic storm was first shown on the 9h. chart on January 20th, the centre being then located off the coast between Derby and Broome. During the next three days the cyclone moved slowly in a south-westerly direction, the centre passing Roebourne on the evening of the 21st. From the morning of the 22nd its intensity appears to have declined very rapidly, no definite centre being apparent by the morning of the 24th. During the 25th to 28th a depression passed eastwards to the south of the continent but there seems no sufficient reason for identifying this with the north-west cyclone.



In Fig. 1 a copy of the Roebourne barograph trace is shown. The discontinuity at 14h. on the 21st is apparently due to a moving of the parts by the observer and a consequent reduction of the lag. The clock appears to have been about 2 hours fast. Fortunately, in addition to the barograph trace we have a series of barometer observations made by the observer at Roebourne at intervals during the approach of the cyclone centre. The barometer observations are indicated on Fig. 1 by the crosses. The record is remarkable both for the great fall of pressure and for the failure of the barograph, a small sized Richard instrument, to record it.

The radius of the central portion of the cyclone was unusually small. As a consequence the damage caused by it was confined to a relatively small area and the rainfall was nowhere excessive, the maximum being 4·76 in. at Abydos. At Roebourne every building is said to have been damaged and a portion of the jetty was carried away. Damage was also caused on some of the sheep and cattle stations between Roebourne and Fortescue on the coast to the south-west. Pearling luggers sheltering in the Cossack Creek near Roebourne experienced a rise of 20 feet in the level of the sea during the storm, some of the surrounding country being flooded.

The wind reached gale force at Roebourne at 15h., blowing in heavy gusts, and attained hurricane force from the south-east or south-south-east at 18h. The observer states that scud appeared to be travelling rapidly from both north-east and south-east at the same time during the storm. At 20h. 40m. a perfect calm occurred and lasted for 40 minutes. This was followed by a renewal of the hurricane with, if possible, increased violence, this time from the north-west. At 23h. 40m. this hurricane just as suddenly ceased.

E. KIDSON.

Health and the Tropics

Dr. Gerhard Castens, in the *Annalen der Hydrographie* for 1925, part 6, discusses the best ways of combating the ill-effects of tropical climate on health. He recommends full exposure to free-moving air combined with a temperate and active life and the fullest use of the diurnal variation of temperature; he states that the bad reputation of tropical climates is a legacy of the old "whisky-colonial" days. The greatest enemy of health is the "sultriness" of the air, expressed by the saturation-deficit of air at the temperature of the body, and he measures this quantity in the open air, in thick-walled houses of the Arabian type, and in modern thin-walled bungalows with free ingress for the air. The modern bungalow with a wide verandah all round is found to be much better than the Arabian house, which greatly raises the sultriness and decreases the diurnal variation; this type is in fact suitable for dry climates with a large diurnal range of temperature but not for moist uniform climates. He supports these conclusions by his experiences during the campaign in East Africa, when the health of the settlers who joined the forces greatly improved during the open air life on the march or in simple grass huts or shelters.

Wind and Tide

Several references to the connection between wind velocity and the state of the tide appeared in the *Meteorological Magazine* during 1922. Sir Napier Shaw (in the February number) mentioned that Captain Hepworth used to insist that the weather changed with the tide; Captain Brooke Smith in the next number stated that in many estuaries where there are sand or mud flats a variation of wind with tide was noticed by sailors; and the May issue contained a communication from Mr. T. F. Twist giving particulars of some of the phenomena in connection with the wind and tide in the Bristol Channel above Minehead.

As a preliminary to a systematic investigation of the question the staff of the Meteorological Office at Holyhead was asked to

make an examination of the recorded wind speed in relation to the state of the tide. The records of a Dines pressure-tube anemometer were utilised; the times of high and low tide were extracted from the Admiralty Tide Tables, and the mean wind speed for the hour during which high or low tide occurred was set out under the two headings, day and night.

The preliminary investigation covered the month of April, 1923; the results showed that during this particular month the mean velocity of the wind at high tide was less than that at low tide by day but greater by night. The examination was therefore extended and the records for the year October, 1923, to September, 1924, analysed in a similar way. The means for each month were calculated; these are set out in the following table, in which the mean velocity derived from the tabulation of hourly readings for the whole of each month is also given.

HOLYHEAD: MEAN WIND VELOCITY IN MILES PER HOUR.

Month.		Day.		Night.		All hours.
		High tide.	Low tide.	High tide.	Low tide.	
1923	October ..	19·9	20·5	19·3	18·7	19·8
	November ..	19·2	19·3	19·4	19·9	19·1
	December ..	19·8	18·1	19·3	18·4	19·0
1924	January ..	16·9	18·1	17·4	17·4	17·3
	February ..	18·8	17·7	15·6	18·3	17·5
	March ..	13·1	11·5	9·4	10·3	10·9
	April	13·8	14·6	12·7	13·3	13·2
	May	15·5	14·7	13·6	13·3	14·1
	June	14·6	13·9	13·1	13·2	13·7
	July	15·3	16·1	15·2	13·7	15·1
	August ..	15·3	16·2	14·2	14·5	15·2
	September ..	17·8	18·5	17·1	17·2	17·9
Mean for Year ..		16·7	16·6	15·5	15·7	16·1

Mean for high tide—16·10, for low tide—16·15.

It will be seen that the results arrived at fail to show up any connection between the state of the tide and the velocity of the

wind at Holyhead. The average wind speed at time of high tide appears to be identical with that at time of low tide and also with the general average so far as this station is concerned.

It will be interesting to see if similar results are shown in the case of other coast stations and especially at the mouths of rivers. It is unfortunate that there is no anemometer on the estuary of the Severn. Perhaps the most useful records for the present purpose will be those from the Lighthouse on the Maplin Sands at the mouth of the Thames.

News in Brief

We regret to learn that Dr. James Niven, for many years Medical Officer of Health for Manchester, died in September at the age of 74, at Douglas, Isle of Man.

Sir Gilbert Walker, F.R.S., will deliver a course of lectures on Dynamical Meteorology at the Imperial College of Science and Technology, South Kensington, on Fridays at 5 p.m., beginning on Friday, October 16th, and continuing to the end of March. The lectures will cover the ground dealt with by F. M. Exner in his book "Dynamische Meteorologie."*

With reference to the heavy rainfall in the south of England on August 23rd mentioned on p. 200 of the September magazine, Capt. J. E. Cowper informs us that in the Isle of Wight 50·6 mm. (1·99 in.) were recorded on that day at Sandown, which is the heaviest 24 hour fall for nearly 20 years except for the fall on December 9th, 1914, when 63·8 mm. (2·51 in.) occurred. During the six days August 19th to 24th, 1925, 111·3 mm. (4·38 in.) fell at Newport, Isle of Wight.

The Weather of September, 1925

Throughout the month the weather was generally cool, unsettled and showery but with many bright periods. During the first few days the wind veered to between northwest and north followed by a marked drop in temperature after the warm weather experienced at the end of August. From about the 4th to the 12th, day temperatures remained for the most part below 60° F. in several districts with occasional ground frosts locally at night, the grass minimum temperature at Rhayader (Radnor) on the 12th being as low as 23° F. Rain fell frequently, though the amounts measured were often small. Thunderstorms occurred on several dates, sometimes accompanied by hail, while snow was reported to be lying on some of the Scotch mountains between the 4th and the 10th. On

* A review of this book is to be found in the *Meteorological Magazine* 60 (1925), 129.

the morning of the 11th the observer at St. Ann's Head (near Pembroke) reported the occurrence of a waterspout some five miles westward. It lasted seven minutes. Between the 11th and 15th the anticyclone centred to the south of Iceland moved slowly across the British Isles giving a few days' dry bright weather with a wider range of temperature but much mist or fog. After the 15th, secondaries associated with a depression spreading south from Iceland caused a renewal of unsettled and warmer weather. On the 19th one such secondary began to deepen rapidly near the north of the English Channel and became the dominant centre as it passed in a north-easterly direction across Great Britain. The wind rose to gale force on exposed parts of the southern and eastern coasts and heavy rain fell locally in the south-western and midland districts of England, *e.g.*, 55 mm. (2·18 in.) occurred at Filey, Yorkshire, and 46 mm. (1·83 in.) at Lincomb Lock (Worcester). Thunderstorms were reported from several places in the north and west on the 19th and in the south on the 21st. On the night of the 21st to 22nd a fresh depression caused very stormy weather on the Atlantic, the " Caronia " reporting force 10 (59 m.p.h.) at 1 a.m. Unsettled rainy weather continued until the 26th when a belt of high pressure spread across the southern districts causing quiet, fair and somewhat warmer weather there with much morning mist or fog. In the north the conditions remained cloudy with rain at times. The total rainfall for the month was more than twice the normal at several stations in the Midlands and south-west England and south-east Scotland, but in parts of western Scotland and south-east Ireland it was below normal, being as low as 58 per cent. at Fort William, Inverness.

Pressure was below normal over northern Europe and Spitsbergen and also over the Atlantic between Newfoundland and the Azores, the deficit amounting to over 5 mb. in the southern part of Scandinavia and in Denmark. Over a belt extending from Greenland to south-west Europe, pressure was somewhat below normal. This distribution favoured north-westerly winds over the British Isles. Temperature was below normal generally, but as much as 7° F. in excess at Spitsbergen and slightly above normal in northern Scandinavia and the south of Spain. Rainfall was above normal in most countries, the excess being as much as 34 mm. at Spitsbergen. At the beginning of the month heavy rains in south-eastern Europe caused the Danube to rise much above its usual level at Budapest. Owing to the steady downpour which lasted several days in the neighbourhood of Hamburg, floods occurred on the Elbe and the Alster about the 9th. The crops suffered severely and many dykes gave way. Snow was reported to be covering the Alps in southern Bavaria down to

3,000 ft. on the 16th, and snowstorms have occurred in the Palatinate. Towards the end of the month heavy rain fell in Switzerland and floods occurred near Lugano and Locarno. In Sweden the rainfall was as much as 100 per cent. in excess in southern Gotaland, and in the coast districts of central Norrland. In the interior, however, it was below normal.

Unusually heavy rain in the Darjeeling district caused numerous landslips between Darjeeling and Siliguri about the middle of the month. On the 19th it was feared that crop failures were almost inevitable in parts of the Bombay Presidency and the Deccan owing to the lack of rain, but later in the month the rains became more normal over the whole of India. A typhoon swept across Kiushiu (Japan) and Fusan (Korea) on the 8th, causing many casualties and much damage, especially at Fusan. On the 20th, another typhoon, but of considerably less violence, passed over south-west Japan from Shikoku to Kiushiu. Extensive floods have occurred on the Yellow River (China) owing to the breaking of the dykes. Many people were drowned and the autumn crops destroyed. It is estimated that 2,000 square miles are under water.

The rainfall in Rhodesia was unusually early and heavy in the first part of the month.

Warm weather was experienced in most parts of North America during the first half of the month, temperatures of over 100° F. being recorded in the southern States. The cotton crop suffered from lack of rain early in the month but later rains revived the plants, though causing some damage to open cotton. Heavy snowfalls are reported in South America between Valparaiso and Mendoza.

In Australia the rainfall was generally about normal in Western Australia, South Australia and Queensland, but below normal in New South Wales and Victoria.

The special message from Brazil states that the rainfall was generally plentiful in the northern districts, being 38 mm. above normal, but irregular elsewhere, with an average 73 mm. above normal in the central districts and 2 mm. below normal in the southern districts. The Atlantic high pressure area withdrew eastwards during the month, while many secondary depressions passed across the country. There was a general improvement in the crops with the ending of the drought. At Rio de Janeiro pressure was 0·4 mb. below normal, and temperature 0·9° F. above normal.

Rainfall September, 1925—General Distribution

England and Wales ..	155	per cent. of the average 1881-1915.
Scotland	135	
Ireland	107	
British Isles	140	

Rainfall: September, 1925: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square.....	2·25	57	124	*War.*	Birminghm, Edgbaston	3·79	96	212
Sur.	Reigate, Hartswood...	2·87	73	147	*Leics*	Thornton Reservoir..	3·33	85	184
Kent.	Tenterden, View Tower	...	...	...	,, .	Belvoir Castle.....	3·26	83	174
,, .	Folkestone, Boro. San.	2·24	57	...	*Rut.*	Ridlington.....	3·15	80	...
,, .	Broadstairs, St. Peter's	2·90	74	148	*Linc.*	Boston, Skirbeck	2·85	72	162
,, .	Sevenoaks, Speldhurst.	2·46	63	...	,, .	Lincoln, Sessions House	2·58	65	167
Sus.	Patching Farm.....	3·76	70	115	,, .	Skegness, Estate Office.	...	...	...
,, .	Brighton, Old Steyne .	3·17	80	155	,, .	Louth, Westgate	2·34	59	116
,, .	Tottingworth Park....	3·28	83	134	,, .	Brigg	2·71	69	160
Hants	Ventnor, Roy. Nat. Hos.	2·25	57	91	*Notts.*	Worksop, Hodsock....	3·13	79	206
,, .	Fordingbridge, Oaklnds	4·18	106	194	*Derby*	Mickleover, Clyde Ho..	4·00	102	223
,, .	Ovington Rectory	3·69	94	161	,, .	Buxton, Devon. Hos...	5·64	143	174
,, .	Sherborne St. John Rec.	2·97	75	145	*Ches.*	Runcorn, Weston Pt...	4·56	116	171
Berks	Wellington College...	2·99	76	163	,, ..	Nantwich, Dorfold Hall	3·96	101	...
,, .	Newbury, Greenham..	2·96	75	147	*Lancs*	Manchester, Whit. Pk.	4·11	104	173
Herts.	Bennington House....	3·26	83	...	,, ..	Stonyhurst College....	4·59	116	120
Bucks	High Wycombe	3·20	81	169	,, ..	Southport, Hesketh...	3·73	95	136
Oxf..	Oxford, Mag. College..	3·11	79	185	,, ..	Lancaster, Strathspey.	4·26	108	...
Nor.	Pitsford, Sedgebrook..	3·08	78	171	*Yorks*	Sedbergh, Akay	5·02	127	120
,, .	Eye, Northolm.....	2·31	59	...	,, .	Wath-upon-Dearne ...	2·27	58	144
Beds.	Woburn, Crawley Mill.	2·68	68	140	,, .	Bradford, Lister Pk...	2·65	67	128
Cam.	Cambridge, Bot. Gdns.	2·54	65	158	,, .	Wetherby, Ribston H..	4·03	102	224
Essex	Chelmsford, County Lab	2·26	57	131	,, .	Hull, Pearson Park ...	3·14	80	183
,, .	Lexden, Hill House...	2·22	56	...	,, .	Holme-on-Spalding ...	3·10	79	...
Suff.	Hawkedon Rectory ...	3·33	85	173	,, .	West Witton, Ivy Ho..	...	...	...
,, .	Haughley House.....	2·74	70	...	,, .	Felixkirk, Mt. St. John	2·93	74	161
Norf.	Beccles, Geldeston....	2·68	68	139	,, .	Pickering, Hungate ...	2·47	63	...
,, .	Norwich, Eaton	...	...	...	,, .	Scarborough.....	2·63	67	147
,, .	Blakeney	2·76	70	148	,, .	Middlesbrough	2·29	58	138
,, .	Swaffham	3·28	83	154	,, .	Baldersdale, Hury Res.	2·73	69	100
Wilts.	Devizes, Highclere....	3·55	90	174	*Durh.*	Ushaw College	2·80	71	139
,, .	Bishops Cannings	3·37	86	154	*Nor.*	Newcastle, Town Moor.	3·62	92	177
Dor.	Evershot, Melbury Ho.	4·30	109	162	,, .	Bellingham, Highgreen	3·30	84	...
,, .	Weymouth, Westham..	...	...	...	,, .	Lilburn Tower Gdns...	5·22	133	...
,, .	Shaftesbury, Abbey Ho.	3·04	77	125	*Cumb*	Geltsdale.....	4·14	105	...
Devon	Plymouth, The Hoe...	3·53	90	144	,, .	Carlisle, Scaleby Hall .	4·20	107	156
,, .	Polapit Tamar	4·08	104	146	,, .	Seathwaite M.....	9·20	234	93
,, .	Ashburton, Druid Ho..	4·89	124	157	*Glam.*	Cardiff, Ely P. Stn.....	5·36	136	173
,, .	Cullompton	5·03	128	224	,, .	Treherbert, Tynywaun	6·46	164	...
,, .	Sidmouth, Sidmount ..	3·52	89	153	*Carm*	Carmarthen Friary....	3·97	101	115
,, .	Filleigh, Castle Hill ...	5·47	139	...	,, .	Llanwrda, Dolaucothy.	4·80	122	118
,, .	Barnstaple, N.Dev.Ath.	4·11	104	152	*Pemb*	Haverfordwest, School	3·79	96	107
Corn.	Redruth, Trewirgie ...	3·23	82	104	*Card.*	Gogerddan.....	4·92	125	135
,, .	Penzance, Morrab Gdn.	2·78	71	95	,, .	Cardigan, County Sch. .	3·41	87	...
,, .	St. Austell, Trevarna..	4·33	110	136	*Brec.*	Crickhowell, Talymaes	4·60	117	...
Soms	Chewton Mendip	5·05	128	164	*Rad.*	Birm. W. W. Tyrmynydd	4·93	125	128
,, .	Street, Hind Hayes ...	3·52	89	...	*Mont.*	Lake Vyrnwy	4·81	122	136
Glos..	Clifton College	3·27	83	139	*Denb.*	Llangynhafal	4·93	125	...
,, .	Cirencester	4·24	108	188	*Mer.*	Dolgelly, Bryntirion..	6·09	155	143
Here.	Ross, Birchlea.....	3·78	96	197	*Carn.*	Llandudno	2·96	75	130
,, .	Ledbury, Underdown.	4·08	104	214	,, .	Snowdon, L. Llydaw 9	13·17	335	...
Salop	Church Stretton.....	3·62	92	178	*Ang.*	Holyhead, Salt Island.	3·59	91	134
,, .	Shifnal, Hatton Grange	3·56	90	184	,, .	Lligwy	3·40	86	...
Staff.	Tean, The Heath Ho...	4·56	116	192	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	4·02	102	227		Douglas, Boro' Cem...	4·00	102	121
,, .	Blockley, Upton Wold.	4·00	102	190	*Guernsey*				
War.	Farnborough.....	4·45	113	209		St. Peter P't, Grange Rd	2·88	73	111

Rainfall: September, 1925: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	4·66	118	167	*Suth.*	Loch More, Achfary...	11·61	295	202
,, .	Pt. William, Monreith .	3·27	83	...	*Caith*	Wick	3·47	88	139
Kirk.	Carsphairn, Shiel.	5·89	150	...	*Ork .*	Pomona, Deerness	3·49	89	120
,, .	Dumfries, Cargen.....	2·94	75	100	*Shet .*	Lerwick	3·74	95	124
Dum	Drumlanrig	2·34	59	79					
Roxb	Branxholme	3·58	91	160	*Cork.*	Caheragh Rectory	3·37	86	...
Selk .	Ettrick Manse.....	4·28	109	...	,, ..	Dunmanway Rectory.	3·14	80	77
Berk.	Marchmont House	4·69	119	195	,, ..	Ballinacurra	2·34	59	93
Hadd	North Berwick Res....	4·42	112	211	,, ..	Glanmire, Lota Lo. ...	3·03	77	108
Midl	Edinburgh, Roy. Obs..	4·39	111	240	*Kerry*	Valencia Obsy.	4·02	102	97
Lan .	Biggar	4·36	111	191	,, .	Gearahameen	6·60	168	...
Ayr .	Kilmarnock, Agric. C..	3·14	80	103	,, .	Killarney Asylum.....	...	...	...
,, .	Girvan, Pinmore.....	4·37	111	114	,, .	Darrynane Abbey	4·76	121	134
Renf.	Glasgow, Queen's Pk..	3·39	86	122	*Wat .*	Waterford, Brook Lo..	2·64	67	95
,, .	Greenock, Prospect H..	3·88	99	82	*Tip .*	Nenagh, Cas. Lough...	1·79	45	64
Bute.	Rothesay, Ardencraig.	4·31	109	106	,, .	Tipperary	2·84	72	...
,, .	Dougarie Lodge	4·34	110	...	,, .	Cashel, Ballinamona ..	2·33	59	95
Arg .	Ardgour House	6·35	161	...	*Lim .*	Foynes, Coolnanes	2·64	67	95
,, .	Manse of Glenorchy..	6·36	161	...	,, .	Castleconnell Rec.	2·07	53	...
,, .	Oban	4·25	108	...	*Clare*	Inagh, Mount Callan ..	5·08	129	...
,, .	Poltalloch	5·62	143	123	,, .	Broadford, Hurdlest'n.	2·51	64	...
,, .	Inveraray Castle.....	5·76	146	90	*Wexf*	Newtownbarry	2·20	56	...
,, .	Islay, Eallabus.....	5·22	133	125	,, .	Gorey, Courtown Ho...	2·94	75	119
,, .	Mull, Benmore	15·20	386	...	*Kilk.*	Kilkenny Castle	...	...	...
Kinr.	Loch Leven Sluice	3·21	81	125	*Wic .*	Rathnew, Clonmannon	2·73	69	...
Perth	Loch Dhu	4·60	117	80	*Carl.*	Hacketstown Rectory .	3·03	77	108
,, ..	Balquhidder, Stronvar.	3·39	86	64	*QCo..*	Blandsfort House.....	2·60	66	96
,, ..	Crieff, Strathearn Hyd.	2·90	74	101	,,	Mountmellick	2·33	59	...
,, ..	Blair Castle Gardens ..	2·69	68	114	*KCo.*	Birr Castle.....	1·84	47	80
,, .	Coupar Angus School..	3·20	81	161	*Dubl.*	Dublin, FitzWm. Sq...	2·18	55	114
Forf.	Dundee, E. Necropolis.	2·92	74	140	,, .	Balbriggan, Ardgillan .	2·53	64	124
,, .	Pearsie House.....	...	...	...	*Me'th*	Drogheda, Mornington	2·64	67	...
,, .	Montrose, Sunnyside..	3·24	82	163	,, .	Kells, Headfort.....	2·88	73	108
Aber.	Braemar, Bank	3·37	86	134	*W.M*	Mullingar, Belvedere .	2·73	69	102
,, .	Logie Coldstone Sch. ..	2·84	72	122	*Long*	Castle Forbes Gdns....	3·82	97	133
,, .	Aberdeen, King's Coll..	2·54	65	114	*Gal .*	Ballynahinch Castle ..	4·14	105	87
,, .	Fyvie Castle	4·26	108	...	*Mayo*	Mallaranny.....	4·76	121	...
Mor .	Gordon Castle.....	4·15	105	166	,, .	Westport House.....	2·76	70	78
,,	Grantown-on-Spey....	4·94	125	199	,, .	Delphi Lodge	6·74	171	...
Na .	Nairn, Delnies.....	3·86	98	176	*Sligo*	Markree Obsy.	4·27	109	126
Inv..	Ben Alder Lodge	3·24	82	...	*Cav'n*	Belturbet, Cloverhill..	2·77	70	112
,, .	Kingussie, The Birches	2·58	65	...	*Ferm*	Enniskillen, Portora ..	2·21	56	...
,, .	Loch Quoich, Loan....	9·00	229	...	*Arm.*	Armagh Obsy.	2·62	67	107
,, .	Glenquoich	7·03	179	81	*Down*	Warrenpoint	3·38	86	...
,, .	Inverness, Culduthel R.	4·07	103	...	,, .	Seaforde	2·83	72	103
,, .	Arisaig, Faire-na-Squir	5·07	129	...	,, .	Donaghadee, C. Stn...	2·98	76	125
,, .	Fort William.....	3·67	93	58	,, .	Banbridge, Milltown .	3·01	77	122
,, .	Skye, Dunvegan.....	4·95	126	...	*Antr.*	Belfast, Cavehill Rd. .	4·55	116	...
,, .	Barra, Castlebay	2·83	72	...	,, .	Glenarm Castle.....	3·99	101	...
R&C	Alness, Ardross Cas. ..	2·62	67	90	,, .	Ballymena, Harryville	4·63	118	149
,, .	Ullapool.....	6·84	174	...	*Lon .*	Londonderry, Creggan	4·83	123	146
,, .	Torridon, Bendamph..	7·04	179	101	*Tyr .*	Donaghmore	3·53	90	...
,, .	Achnashellach	6·08	154	...	,, .	Omagh, Edenfel	...	...	...
,, .	Stornoway	3·88	99	98	*Don .*	Malin Head	2·93	74	112
Suth.	Lairg	2·54	65	...	,, .	Rathmullen.....	4·47	113	...
,, .	Tongue Manse.....	5·25	133	165	,, .	Dunfanaghy	...	...	...
,, .	Melvich School.....	5·19	132	185	,, .	Killybegs, Rockmount.	4·71	120	102

Climatological Table for the British Empire, April, 1925

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1011·3	− 3·1	61	30	54·5	39·2	46·9	− 0·4	40·0	85	7·3	50	+ 13	18	4·4	32
Gibraltar	1018·1	+ 1·6	75	46	67·7	52·5	60·1	− 0·9	51·5	81	3·4	1	− 67	1	...	...
Malta	1014·4	+ 0·4	77	52	65·2	56·0	60·6	− 0·3	55·7	79	6·3	7	− 15	5	7·0	53
Sierra Leone	1010·9	− 0·1	95	68	90·5	74·2	82·3	− 0·5	76·3	75	5·6	70	− 33	8	...	...
Lagos, Nigeria	1008·2	− 1·6	91	71	89·1	76·6	82·9	+ 0·6	78·4	78	7·8	178	+ 29	10	...	...
Kaduna, Nigeria	1011·3	+ 0·6	99	...	92·8	...	...	...	72·0	58	1·0	43	− 41	3	...	...
Zomba, Nyasaland	1012·6	+ 0·1	83	59	80·7	63·5	72·1	+ 2·9	...	90	8·9	144	+ 47	24	...	...
Salisbury, Rhodesia	1012·8	− 0·5	80	49	76·9	56·9	66·9	+ 1·0	61·7	74	4·3	53	+ 27	12	8·3	71
Cape Town	1016·6	+ 0·5	101	46	75·2	55·3	65·3	+ 2·0	55·6	74	3·8	12	− 39	4	...	...
Johannesburg	1017·5	+ 0·4	75	46	65·8	51·2	58·5	− 1·1	53·4	84	6·0	107	+ 55	15	5·2	46
Mauritius	1015·6	+ 1·6	84	66	81·3	70·2	75·7	− 0·1	72·9	74	5·9	263	+149	18	7·8	68
Bloemfontein	...	...	78	45	71·3	51·0	61·1	+ 0·3	55·6	89	5·5	82	+ 28	14	...	...
Calcutta, Alipore Obsy.	1006·8	+ 0·5	102	69	94·4	76·3	85·3	− 0·4	77·4	81	5·5	85	+ 37	6*	...	...
Bombay	1008·5	− 0·3	94	76	91·1	79·7	85·4	+ 2·3	77·0	71	2·8	0	− 1	0*	...	...
Madras	1008·2	− 0·2	98	74	93·3	77·6	85·5	+ 0·2	78·7	73	3·9	1	− 12	0*	...	...
Colombo, Ceylon	1009·3	+ 0·2	91	73	88·3	75·7	82·0	− 0·6	78·5	73	7·7	405	+206	14	7·3	59
Hong Kong	1015·1	+ 2·4	81	52	70·0	61·8	65·9	− 4·9	62·1	81	8·1	201	+ 66	11	3·7	29
Sandakan	...	...	90	74	87·2	75·3	81·3	− 0·9	77·8	82	...	209	+103	10	...	...
Sydney	1020·6	+ 2·0	84	51	74·0	58·4	66·2	+ 1·6	60·1	72	4·9	53	− 82	14	6·3	56
Melbourne	1021·4	+ 2·0	88	44	70·7	52·1	61·4	+ 1·9	54·5	67	6·4	38	− 19	9	6·2	55
Adelaide	1021·3	+ 1·5	92	45	74·6	54·4	64·5	+ 0·7	55·3	52	5·4	27	− 19	8	6·5	59
Perth, W. Australia	1020·1	+ 1·6	88	44	75·2	56·6	65·9	− 0·7	58·8	63	4·5	12	− 28	7	7·6	67
Coolgardie	1019·0	+ 0·5	97	41	78·4	54·4	66·4	+ 1·3	54·4	52	2·2	83	+ 59	6	...	...
Brisbane	1019·6	+ 2·0	85	44	77·8	59·6	68·7	− 1·6	62·4	68	4·1	25	− 66	12	7·8	68
Hobart, Tasmania	1017·7	+ 3·2	76	37	61·8	48·4	55·1	0·0	49·0	72	7·7	50	+ 2	16	4·8	44
Wellington, N.Z.	1020·9	+ 3·1	72	40	63·6	50·6	57·1	+ 0·1	53·3	75	5·9	67	− 34	10	6·1	56
Suva, Fiji	1010·1	− 0·5	91	71	85·3	73·8	79·5	+ 0·8	75·9	81	7·6	341	+ 54	20	...	...
Apia, Samoa	1010·3	+ 0·4	89	72	86·4	74·7	80·5	+ 1·6	77·3	76	4·5	246	− 14	16	7·2	61
Kingston, Jamaica	1012·8	− 1·3	90	67	87·2	69·7	78·5	+ 0·1	69·5	77	3·0	69	+ 38	9	...	...
Grenada, W.I.	1013·1	+ 0·5	88	71	85·1	74·0	79·5	+ 0·7	73·9	70	5·4	14	− 46	9	...	...
Toronto	1017·4	+ 1·9	79	25	54·3	36·1	45·2	+ 3·8	39·7	68	3·5	33	− 28	6	8·2	61
Winnipeg	1016·3	− 0·7	71	24	54·7	34·9	44·8	+ 7·0	...	...	5·4	28	− 10	9	7·0	51
St. John, N.B.	1014·6	+ 1·0	64	22	46·9	31·2	39·1	+ 0·1	33·2	73	5·8	77	− 12	10	6·1	45
Victoria, B.C.	1016·5	− 0·8	71	39	55·1	42·9	49·0	+ 1·3	42·3	85	5·3	43	− 1	13	6·2	45

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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The International Ice Patrol

By Lt.-Comdr. EDWARD H. SMITH, U.S. Coast Guard.

ONE of the gravest natural dangers which seamen of the North Atlantic have had to combat from early recorded times is that of floating ice. Winter conditions nowadays in the far north are especially favourable for ice production, and, in consequence, every spring two prominent ice streams project southward into the Atlantic. The general system of winds and currents casts an ice girdle along the eastern coast of Greenland and at the same times drives an equally imposing mass of white out of the north-west and the famous Baffin Bay. This last-mentioned ice, in which we are particularly interested, stretches a barrier far out into the Atlantic, the end of which often extends several hundred miles south of London in the longitude of Newfoundland. If we glance at a general map (see figure), we notice that the Arctic ice which is borne southwards along the western side of the North Atlantic, is greatly influenced by the bathymetrical configuration of the basin. Current and ice stream are preserved and guided by the continental slope of North America, which extends without great change in direction from the region of Baffin Land to the Tail of the Grand Banks. It has been justly remarked that the continental shelf, before finally merging into the ocean floor south-east of Newfoundland, juts out into the Atlantic to a point halfway between Pole and Equator.

It was off the Tail of the Grand Banks that the giant passenger

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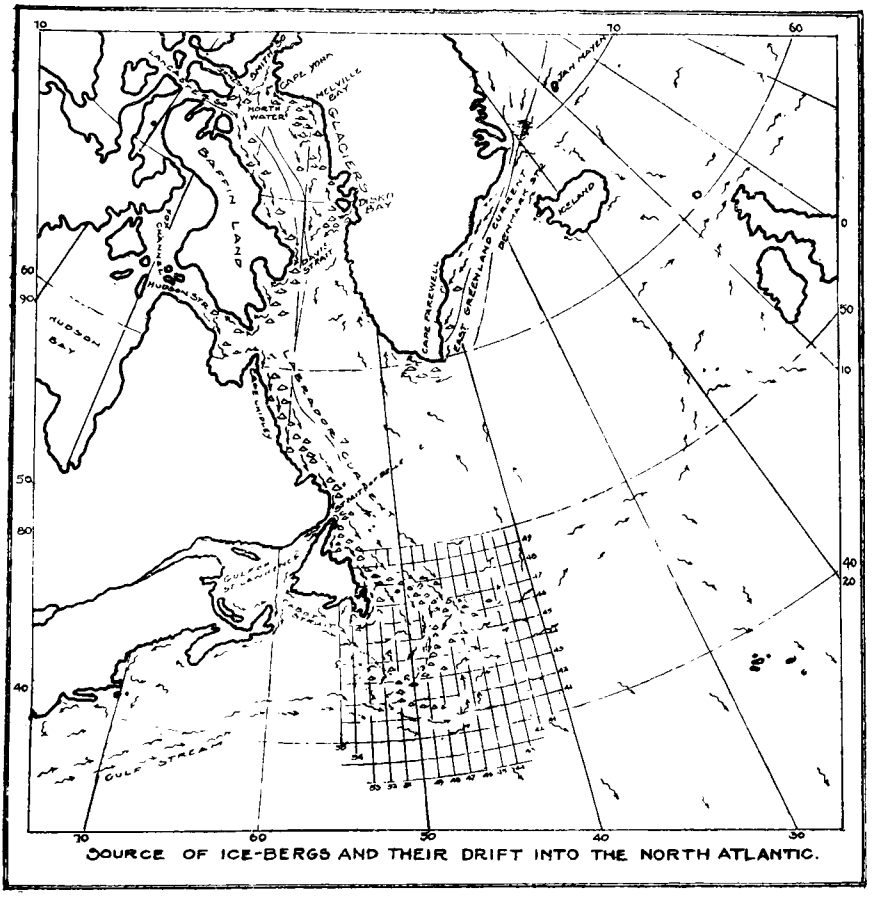
ship "Titanic" met the southern end of the Arctic barrier on the night of April 14th, 1912, and collided with a treacherous low-lying iceberg unseen by the bow look-outs. This most appalling marine disaster of modern days proved a culminating event, against the repetition of which measures were taken at an International Convention in London, 1914. It was decided at that Conference to establish a patrol of the ice regions of the North Atlantic, in order that all future navigators might be supplied with information regarding dangerous floating ice. The practicability of such a plan was insured by Marconi's then recent invention in wireless, which a few years previously had been installed extensively on ocean-going steamers. The United States accepted the actual management of the Ice Patrol service, each nation a party to the agreement binding themselves to share the expenses of such a project in proportion to the official shipping tonnages of each. (Great Britain contributes approximately thirty per cent. of the total outlay of funds.)

It has devolved upon the United States Coast Guard to furnish the Patrol with ships and personnel. The U.S. Hydrographic Office co-operates with the Coast Guard in giving publicity to the ice information. Under this general programme (with the exception of the war years 1917 and 1918, when the service was suspended), the Patrol has been operating for the past thirteen years. Collisions and damages on account of ice have occurred on some of the northern routes near Newfoundland, as they probably always will, but to the writer's knowledge there has not been a single life lost or a serious marine accident on the United States-Europe routes since Ice Patrol inception.

The work has two main features, viz.: (1) the practical task of locating all ice threatening the steamship tracks, and the duty of placing that information in the hands of every steamship captain; and (2) the making of such scientific observations as will lead to a better understanding and administration of the practical work. The former aspect is, of course, of primary importance, and depends upon a programme of intelligent scouting combined with an efficient system of radio communication.

The Patrol, in searching for menacing ice, finds it in two general forms, as it hails from two different sources, viz., sea ice and land ice. The former is the name given to ice formed on salt water, commonly known to seamen as field ice, and, being flat, is easily moved by prevailing winds and superficial currents. The field ice season south of Newfoundland usually lasts from February to May. Land ice, as it is met floating in the sea, consists of parts broken off from the ice sheets which cover certain land areas in the far north. Floating land ice, or icebergs, as they are commonly termed, because of their size and form, constitute a

far greater menace to navigation than does sea ice. The iceberg season may be said to cover the period March 15th to July 15th. The compiled drifts of icebergs, from a record kept by the Patrol, 1913-1925, indicate a tendency towards uniformity, both as to velocity and direction. The most dangerous bergs, that is those which reach low latitudes, generally follow a course which lies more or less parallel to the trend of the continental slope until



SOURCE OF ICE-BERGS AND THEIR DRIFT INTO THE NORTH ATLANTIC.

they arrive at the gateway to the Atlantic—The Tail of the Grand Banks (see figure). In this critical region of the North Atlantic, where two mighty currents meet, the drift of the icebergs cannot be foretold, but we observe that the majority of the bergs set south-westward until caught in the northern edge of the Gulf Stream, along which they are borne, to the east and the north-east. Continually lashed by the surrounding warm water, they disintegrate rapidly, and within a week's time no longer constitute a menace to navigation. The Patrol makes every effort to keep in touch with all such icebergs, sending out wireless broadcasts

twice daily regarding their position and drift. Every night an ice report is sent to the U.S. Hydrographic Office, and this is then made the subject both of radio broadcasts from U.S. coastal stations and printed notices to departing ships for Europe. Every day there are many ships which ask the Patrol for special ice information affecting their particular routes, and, in addition, two meteorological reports are forwarded to the Weather Bureau, Washington. It can be readily appreciated that an efficient and active radio communication is demanded, and to this end the ships are equipped with a complement of trained operators and the most powerful wireless equipment on the Atlantic.

The " Tampa " and the " Modoc " are the two ships detailed for Ice Patrol duty. They are 240 ft. in length, fitted with electric drive turbines capable of attaining a speed of 16 knots, and they carry one single, tall mast for long distance radio work. They base upon Halifax, Nova Scotia, each ship alternating with fifteen days in the ice regions south of Newfoundland. The practical work of ice scouting is greatly hampered, at times, by inclement natural elements. The prevailing atmospheric pressure distribution produces strong north-westerly winds over this region of the North Atlantic in winter, and less intense south-westerly winds later in the season and in summer. These two types of circulation are often interrupted, especially in winter, by irregular winds associated with low pressure centres moving eastward, the mean tracks of which follow a path along the northern edge of the Gulf Stream. It can be imagined that in the early ice season, both the practical, as well as the scientific work, is carried on with great difficulty, midst continually veering gales that lash these waters into a veritable fury. In the latter part of the ice season, May-July, the prevailing air circulation becomes southerly, and the gradients grow less intense. Warm winds blowing over the icy waters around the Banks bring a fog sheet which often does not lift for weeks at a time. The fact that the region most infested by bergs is also the region enveloped in fog for a large percentage of the time, greatly increases the danger of collision with ice.

It was early realised that the Patrol could not give its best service to shipping unless a carefully planned scientific programme was begun from which conclusions of practical value might be drawn. The most important natural problems confronting the Ice Patrol have been: (1) determination of the position of an iceberg when not visible because of fog, snow, or darkness; (2) information regarding the probable drift of ice after arriving at the gateway to the Atlantic; (3) advanced information about the annual amount of ice to be expected south of Newfoundland.

(1) No device has yet been constructed which detects the presence of an iceberg, the proximity of which is unknown because

of low visibility. The Patrol is conducting at present, however, a series of experimental tests with a new invention by which it is hoped to locate the position of a berg by means of submarine echo. Sounds emitted from a submarine sonic apparatus may be reflected by the under-water body of a berg in such a manner that the echo can be caught in a microphone.

(2) If the Patrol had knowledge of the drift tracks which bergs would follow after arrival at the Tail of the Grand Banks, much more detailed reports could be furnished to approaching vessels, especially during the protracted periods when fog enshrouds the cold-water region. The Patrol has found that the drifts of nearly all bergs are primarily controlled by relatively deep-seated ocean currents, and the effect of the winds such as those which usually prevail from April to July in this region, are practically nil. A monthly current map (for oceanic circulation does not fluctuate so rapidly as does the atmospheric) of this critical area, where the Labrador Current and Gulf Stream meet, is an indicator of the courses menacing bergs will tend to follow. A practical means of determining the circulation over a given oceanic area will be instituted on the 1926 Patrol: the methods employed are based upon the general theories propounded in Bjerknes' "Dynamic Hydrography and Meteorology," *Carnegie Institute Publications*, 1910. The success or failure of forecasting by such a programme as suggested above, depends to a great extent upon the rate at which variations take place in the courses of the currents. Obviously, little reliability can be attached to a monthly current map if important changes occur in the circulation from day to day, or week to week. Investigation of this particular question has been recently carried on at the Geo-Physical Institute, Bergen, Norway, under the supervision of B. Helland-Hansen, use being made of the material collected by the Ice Patrol around the Grand Banks in years past. The requisite data consist of salinity and temperature observations at several depths and from stations scattered net-like over the investigated area. We have found several different positions occupied by the two counter streams (the Labrador Current and the Gulf Stream) at the gateway to the Atlantic, depending partly upon the relative volumes of each in particular years, and also upon the time within a given year. Alterations in direction and velocity of the currents, however, take place at such a slow rate, that a current map constructed along the lines described above will continue to be of value for a period of even three or four weeks.

Several interesting discoveries have been revealed in the course of this work, and may be alluded to briefly. The famous "cold-wall" of oceanography, which is so clearly delineated along the entire American coast, does not mark the boundary between the

Gulf Stream and the variable counter-set inshore, as is commonly supposed. The change in flow, on the contrary, is located at the density-wall, and this phenomenon, it was found, lies 20 to 30 miles inshore of the famous " cold-wall " around the Grand Banks. If this be a hydrostatic phenomenon, it may be attributable to the inshore water salting faster than it warms, but in any case it causes a considerable amount of the icy water to flow in the same direction and parallel to the Gulf Stream. The dissimilarity, too, between the positions of the " cold-wall " and the " density-wall " more or less upsets a view, hitherto held by many, that an intense sinking of the water (especially that from the Arctic), is constantly taking place along the length of the " cold-wall." Further, the belief is not tenable that the Labrador Current dives beneath the Gulf Stream, for, as a matter of fact, the edges of these two currents have about the same density where they meet. The resulting mixture, it is true (as proved by Hydrographical Tables), is denser than either one, yet even this can cause no actual sinking of the water particles, because our rotating earth relegates movements solely to a lateral current in a direction making an angle of 90 degrees with the density gradient. Sir Napier Shaw, in *The Air and its Ways*, has pointed out an analogous condition, where the vertical descent of air in high pressure systems is about 300 ft. per day ; a movement which is really negligible when compared with the lateral velocity of the wind around such centres. Meteorologists, and others, who are constantly meeting problems which involve the important influence that the sea is known to exert upon our weather, will do well, when treating the sea, to employ the great parallelisms existing between the dynamic laws for the sea and for the air.

Let us return from this digression to the third important problem of the Ice Patrol, namely the great annual variations in the distribution of ice south of Newfoundland. If the master of the " Titanic " had known, as we can clearly see to-day, that the year 1912 was one in which icebergs by the hundreds invaded the North Atlantic to low latitudes, he would have navigated his command farther south and more cautiously past the Arctic ice barrier. The amount of ice drifting out of the north into the open Atlantic is subject to great annual variations. Several investigations have been made of the relation between amounts of ice in the north-eastern North Atlantic*†‡ and logical contri-

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* MEINARDUS, W. Periodische Schwankungen der Eistrift. *Ann. Hydr. Hamburg*, 1906. pp. 148-9, 227-239, 278-285.

† WEISE, W. Polareis und atmosphärische Schwankungen. *Geog. Ann. Stockholm*, 6 (1924). pp. 273-299.

‡ BRENNECKE, W. Beziehungen zwischen der Luftdruckverteilung und den Eisverhältnissen des Ostgrönländischen Meeres. *Ann. Hydr. Hamburg*, 1904. pp. 49-62.

butory factors, but only a few similar papers have dealt with the ice stream past Newfoundland*‡.

It is interesting to note, however, that all these investigators find the wind to be the most important influence which governs the southward drift of the Polar ice. The writer, with the assistance of the material in the Meteorological Office Library, South Kensington, has been comparing various pressure gradient effects with the ice distribution past Newfoundland. This work has been carried on in the interests of the International Ice Patrol with the express hope that results would justify, and lead to, the publication of a North Atlantic ice forecast, the value of which has been pointed out in the example given of the year 1912. The period investigated embraces forty-five years (1880-1924), a series of sufficient length to permit mathematical correlation, and in this respect it has an advantage over previous works.

The results differ somewhat from those previously obtained by Mecking* in that the chief importance is assigned to the variations of the pressure difference between Belle Isle, in Newfoundland, and Ivigtut, in South Greenland, during the period December to March. This pressure difference directly affects the amount of field ice, and it has been found that there is a very close relation between the amount of field ice and the number of bergs south of Newfoundland. The field ice tends to act as a fender along the shoreward side of the Labrador Current, and thus more or less prevents the icebergs from stranding as they are borne southwards. The truth of this statement was curiously revealed during the 1924 Patrol, when the unusual absence of field ice left the season's crop of bergs to strand in the northern waters. When the sea ice recedes northward, due to melting in May, the coastline becomes more and more exposed. Stranding takes place on a great scale, and the consequent supply of bergs to the Grand Banks is cut off. The iceberg menace to steamships in the North Atlantic would be greatly diminished, or practically disappear, if sea ice did not hamper the North American coast line from February to March every year. The pressure difference between Bergen and Stykkisolm during the period October to January was also found to be of importance.

The use of the pressure difference between various points furnishes the best data for forecasting purposes, because there is no room for the personal bias which may come in when charts are classified according to types. A classification of the charts of pressure anomaly over the North Atlantic during the period

* MECKING, L. Die Eistrift aus dem Bereich der Baffin Bai usw. *Veröff. Inst. Meeresk Berlin* 7, 1906. p. 148.

‡ SCHOTT, G. Über die Grenzen des Treibeises bei der Neufundländbank sowie über eine Beziehung zwischen neufundländischen und ostgrönländischen Treibeis. *Ann. Hydr. Hamburg*, 1904. pp. 305-309.

December to March has, however, been made, and this distinctly reveals two types of pressure distribution—a plus type, in which an excess of pressure centred in the region of Iceland more or less dominates the Atlantic north of the Azores, and a minus type when reverse conditions prevail. The plus type is subject to further classification into "1" and "2," depending upon a relatively great or moderate intensity of the excess pressure mass, both of which are reflected in a relatively very light, or light, ice year respectively in the western North Atlantic. The minus type, although unmistakably showing a greater amount of ice than normal, does not permit sub-grouping. In other words, the plus type of pressure conditions exhibits a higher correlation with poor ice years than does the minus type with correspondingly rich ice years. This indicates the presence of other factors, such as variations in the air and water temperatures in the far north, or variations in precipitation, or perhaps an unnatural phenomenon, such as an ice jam in the Arctic archipelago.

Although the investigation is not yet completed at the present writing, the results already indicate a high degree of success for such a method of ice forecasting. Correlation coefficients have been calculated between the following variables :—

(A) Number of bergs (on a scale of 0—10).

(B) Amount of field ice (on a scale of 0—10).

(C) Pressure difference (in millibars) between Belle Isle and Ivigtut, combined with the deviation of pressure from normal at Stykkisholm during the period December to March. The mean pressure difference is calculated from the combination : $4 \times$ Dec. $+ 3 \times$ Jan. $+ 2 \times$ Feb. $+ 2 \times$ March, and this mean is combined with the pressure deviation at Stykkisholm in the proportion of six to one.

(D) The pressure difference between Bergen and Stykkisholm during the period October to January inclusive, December being given double weight.

The correlation coefficients employed in the preparation of the forecast were as follows :—

Between (A) and (B)	+ 0·87
Between (A) and (C)	— 0·62
Between (A) and (D)	+ 0·60

At the end of March a forecast of the number of bergs can be prepared by means of the regression equation :—

$$\text{Bergs} = 4{\cdot}9 - 0{\cdot}11\ (\text{C}) + 0{\cdot}05\ (\text{D}).$$

At the end of the field ice season, April 15th, the number of bergs, May to July, can be predicted very closely by making use of the high correlation between field ice and bergs.

Arrangements are now being made to begin a service of North Atlantic ice forecasting, based on these relationships, and beginning with the season of 1926.

Weather Forecasting with the Help of the Sun

IT is well known that practically the whole of the energy involved in maintaining the circulation of the earth's atmosphere is derived from the sun's radiation. The determinations of this quantity, carried out by the Astrophysical Observatory of the Smithsonian Institution since 1906, appear to show that it is not really a constant, but may vary by at least six per cent. on either side of the mean. These variations, if real, ought to be followed by changes in the atmospheric circulation and in fact, logically, they should account for all such variations. If by patient research we can unveil the mechanism of the connexion between solar and atmospheric phenomena, we shall have added a powerful weapon to the forecaster's armoury. Some years ago Mr. H. H. Clayton, as a result of investigations in the Argentine, considered that he had sufficient knowledge to bring this weapon into use, and weekly forecasts for Buenos Aires based only on solar observations have been issued regularly since July, 1922. Mr. Clayton has lately been engaged on similar researches in North America, and for some months has been making experimental long-range forecasts for New York.

The results of these attempts have recently been described in three monographs* published by the Smithsonian Institution. The first is a reply by Dr. C. G. Abbot to a criticism which had been made against the validity of the solar observations themselves. Professor Marvin had pointed out that the magnitude of the day-to-day variations of the calculated " solar constant " was much greater in the earliest observations than in the most recent, and showed a steady decrease throughout the whole period. If the rate of decrease is maintained these day-to-day fluctuations will practically disappear in a few years and only the long-period variations will remain. This suggests that the differences between one day and the next are mainly "accidental," due to deficiencies in the methods, which are gradually being eliminated with improvements in skill, knowledge and instrumental equipment. Dr. Abbot has investigated these criticisms in detail, and makes out a satisfactory case for the reality of the short period fluctuations, although he admits that the observations are not yet impeccable and that further improvement is required before forecasting by the sun becomes really reliable. The fluctuations have shown a close relation with the presence and especially with the position of sunspots, and Mr. Clayton has succeeded in making successful forecasts of the solar

* *Smithsonian Miscellaneous Collections*, Vol. 77, No. 5, Solar Variation and Forecasting, by C. G. Abbot; No. 6, Solar Radiation and Weather, or Forecasting Weather from Observations of the Sun, by H. H. Clayton; No. 7, Solar radiation and the Weekly Weather Forecast of the Argentine Meteorological Service, by Guillermo Hoxmark, Washington, 1925.

constant five days ahead by means of visual observations of the sun.

In the second paper Mr. Clayton describes the basis of his North American forecasts. On days with high solar radiation an anti-cyclone appears in the west of North America, and, the higher the solar radiation, the further north is the location of the anti-cyclone. With low solar radiation a depression appears, with a similar variation in location. The anti-cyclone or depression moves eastward in the usual way, and three days later it affects the Atlantic coast. The element actually selected for experimental forecasts was temperature at New York; a temperature 5°F. or more above the normal for the day was termed high, one 5°F. or more below the normal was termed low; between these limits was "normal." Forecasts were made three, four and five days ahead, and the results for a year are as follows:—

Temperature forecast.	Mean difference of temperature from Normal on days forecasted as:		
	Above Normal.	Normal.	Below Normal.
3 days ahead	+1·6	—0·6	—1·0
4 days ahead	+1·0	—0·2	—1·3
5 days ahead	+0·5	—0·1	—0·8

Complete accuracy would require the figures in the column under "high" to be above +5°F. and in that under "low" to be below —5°F. The results for weekly and monthly forecasts were similar. It is evident that although there must have been a large percentage of failures, the results are on the whole in the right direction.

The third paper, dealing with the results in the Argentine, enables us to enamine the present value of the new methods in greater detail. The 8 a.m. and 8 p.m. temperatures at Buenos Aires are predicted for a week in advance entirely from the solar observations (the daily forecast service is a separate department). These fourteen predictions are then correlated with the recorded temperatures. The method is not entirely satisfactory, since it takes account only of the changes from day to day and not of the general level of the figures. If the two curves, predicted and observed, ran exactly parallel, the correlation would be +1·0, although there might be a difference of 10°F. between them; on the other hand, if they were both much above normal, throughout, but fluctuated independently, the correlation would be zero or negative. Out of 131 correlation coefficients obtained in this way 87 were positive and 44 negative, and the algebraic mean of the whole series was +0·21. Only 30 coefficients, or 23 per cent. were above +0·6. These results, although they show that there is undoubtedly some connexion between solar variations and the subsequent

temperature at Buenos Aires, fall very far short of the high standard required in forecasting weather for practical purposes. The rainfall forecasts were more successful; rain fell on the day for which it was forecasted on 52 per cent. of the occasions.

It will be noticed that the pressure changes which bring about the changes of weather originate near the west coast of America on the same day as the change in solar radiation. This puts the eastern coasts in the most favourable position for long range forecasts based on solar observations. The weather of western Europe is largely governed by movement of barometric disturbances from the Atlantic, and here the relation between solar and meteorological changes is probably even more complex. A relation of some sort almost certainly exists and will be discovered by future research, but it will probably be long before this new method will be able to add anything to the high technique of daily forecasting by synoptic charts.

Discussions at the Meteorological Office

October 12th, 1925. *Die Schwankungen der atmosphärischen Zirkulation über dem Nordatlantischen Ozean im 25-jährigen Zeitraum*, 1881-1905. By A. Defant (Geog. Ann. Stockholm VI., 1924, p. 13). *Opener*—Mr. R. G. K. Lempfert, M.A.

Defant has devoted a great deal of attention to the monthly charts of the distribution of pressure over the North Atlantic, published by the Dansk Meteorologisk Institut, Copenhagen, and the Deutsche Seewarte, Hamburg. In this paper he classifies the monthly charts into four types, according to the latitudes in which the pressure was above or below normal, and thus boils down the data for each month into a single symbol (with an index of intensity.) He regards the frequency and intensity of different types as a measure of the activity of the atmospheric circulation over the North Atlantic, and compares it with other elements such as rainfall in Great Britain, ice in Iceland. Seeking for a cause of variations in the activity of the circulation, he finds that volcanic eruptions are important. In the year of a great eruption, the activity of the circulation is diminished; after the very greatest eruptions, such as Krakatoa in 1883, the circulation does not immediately settle down into its normal state, but oscillates for some time with a period of $3\frac{1}{2}$ years. An interesting discussion followed, in which the general feeling was that, in spite of the immense amount of labour which Defant had given to the work, no outstanding results had emerged. Mr. D. Brunt pointed out that the $3\frac{1}{2}$-year periodicity was very frequent in meteorological phenomena; Mr. F. J. W. Whipple said that it was impossible for the atmosphere as an atmosphere to have a periodicity of this length, because of the mobility of the air: there must be some other factor, which might be the snowfall.

October 26th, 1925. *Die atmosphärischen Elektrizität über den Meeren.* By K. Kähler (Ann. Hydr. Hamburg, Bd. 52, p. 201). *Opener*—Mr. R. E. Watson, B.Sc.

In spite of the difficulties of measurement on board ship, especially of potential gradient, many observations of atmospheric electrical phenomena have been made over the oceans, and the author of the above paper has collected together results published up to 1923. The data indicate that electrical phenomena over the oceans are of the same magnitude as over land, except that there is a large decrease in the radio-activity of the air and an increase in penetrating radiation on passing from land to water. Also, owing to the absence of pollution and the varying radio-active effect of the ground and the steadiness of meteorological conditions over the sea, electrical phenomena are more uniformly distributed over it than over the land. Mauchly's hypothesis, that the regular daily variation of potential gradient over the oceans depends on universal time, is not sufficiently confirmed.

During the discussion, Dr. Simpson described some of the experimental difficulties he had to overcome in carrying out electrical observations aboard ship, and emphasized the need for more accurate standardisation of all potential gradient records. Dr. Chree showed how the potential gradient is increased and the electrical conductivity of the air is reduced by the pollution in the air near large towns. He expressed the opinion that a more systematic co-ordination of observations is required before a general theory of the variation in the earth's electric field can be evolved.

The subjects for discussion for the next meetings will be :—

November 23rd, 1925. *The Kalahari Project.* By E. H. L. Schwarz (Matériaux pour l'étude des calamités, 1. (1925), pp. 291-332). *Opener*—Mr. C. W. Lamb, B.Sc.

December 7th, 1925. *Ozone as an absorbing material for Radiations in the Atmosphere.* By C. Fabry. (Pub. Mass. Inst. Tech., No. 281, 1925, pp. 20). *Opener*—Mr. C. E. Britton, B.Sc.

Correspondence

To the Editor, *The Meteorological Magazine*

Buddha's Glory

REFERRING to my description of " The Spectre of the Brocken," as seen by me on Scafell, in the August *Meteorological Magazine*, the following extract from a letter from West China is of interest. The writers are Mr. and Mrs. William G. Sewell. The former was late lecturer on applied chemistry at Leeds, is now in Chengtn

as missionary and as professor there in the Union University. He and his wife, spending their vacation on the "hills" 5,000 feet above the sea, climbed Gin Din "the Golden Summit," 11,000 feet high—the summit, a narrow ridge with numerous temples, overlooks a precipice, in one part having a sheer drop of a mile. The views, when not cloud hidden, can hardly be equalled, stretching for 200 miles to the lofty summits in Tibet. From their temple lodgings they saw "one of the 'miracles' of the mountains three times. At certain times of day, if the clouds are right, you can look over the edge and see your shadow on the clouds below. You are transfigured in the process and see yourself with a white halo and round that a semicircle of rainbow. It is called Buddha's glory. Pilgrims, seeing in it the welcoming Buddha, have leapt into its arms to be killed on the cliffs below. And then physics comes along and explains it all away—one more superstition is shattered and God is revealed purer and truer."

The *Children's Pictorial* of August 29th has a picture of the Brocken Spectre as seen that month from Cader Idris, but incorrectly centering the circles at the stomach instead of the eye!

J. EDMUND CLARK.

41, *Downscourt Road, Purley, Surrey. October 1st*, 1925.

A Curious Optical Phenomenon

ON the evening of Saturday, September 26th, I saw a very beautiful spectacle, and one which I had never previously witnessed. There was a shower that evening between 5 and 6 p.m., and shortly after 6 a rainbow appeared in the south-east, opposite my house. We were watching the rainbow—which appeared to rest on the hill top—along with two little boys of 5 years of age. Suddenly between us and the hill there appeared a number of bright, pure, white lights, with much sparkle. They seemed as brilliant and looked as big as motor headlights, and were all moving about in a cluster; one of the boys cried out: "Look at the aeroplanes painted silver!" The sky was dull and birds flying could not be seen distinctly from our position unless they rose above the hill top. The lights were midway up. They disappeared for a moment and then came into being again, when it was noticed that they were the reflection of light on a considerable number of black-headed seagulls all wheeling together, only the white undersides being illuminated as they wheeled in and out of a narrow belt, beyond which, on each side, they could hardly be picked up against the hill. I have said the light was reflected—and evidently from below—as there was no sunshine visible; and the light was confined to a certain space. On saying that what we

saw were not aeroplanes but birds, the other little boy said: "They have sparks inside."

The remarks of the children really gave a good description of the appearance and twinkling of the light. I thought the twinkle would be caused by the movement of the wings. If seen from a distance which made it impossible to see the birds, any spectator must have beheld it with great wonder.

Our point of observation was 450 feet above sea level. The hill top is from 600 to 700 feet above the same and the width of the valley at the place about $\frac{3}{8}$ mile. The gulls were flying at an elevation of probably 400 feet above sea level. The light might have been reflected from the river.

Probably such an occurrence may not be infrequent and can be explained. To us it was a sight not likely to be forgotten by the "grown-ups" who saw it. It lasted about 10 minutes.

JOHN G. WINNING.

Branxholme, Knowe, Hawick. October 1st, 1925.

[In connexion with the above, Major A. H. R. Goldie remarks that the "motor lamp," "silver," and "spark" effects in this particular case may have been due to the fact that coloured rays from the rainbow were available, and that each turn of the gulls flashed the various colours of the spectrum in succession into the eyes of the observers. Light reflected from the river may or may not have played a part.—Ed. *M.M.*]

NOTES AND QUERIES

The Third International Air Congress

THE Third International Air Congress was held at Brussels from the 6th to the 10th of October, under the Presidency of Major-General Von Crombrugge, Director-General of Aeronautical Services. About four hundred delegates attended; they included Sir Samual Hoare, Secretary of State for Air, and Air Vice-Marshal Sir Sefton Brancker, Director of Civil Aviation, from England; M. Laurent Eynac, Under Secretary of State for Aeronautics, France; and Signor Mercanti, the representative of Italy on the International Commission for Air Navigation.

The work of the Congress was divided into six sections, and after the opening meeting of the full Congress on Tuesday morning, the members separated to attend the meetings of the particular sections in which they were most interested. Over eighty papers had been received, and most delegates found that their time was very fully occupied. This was particularly the case with certain members, as meetings of the International Commission for Air Navigation and of the Conference on questions affecting civil aviation between Great Britain, France, Belgium and Holland were held during the same week.

It was gratifying to note that no less than fourteen of the papers were on meteorological subjects, a striking proof of the increasing recognition of the importance of meteorology in relation to the various aspects of aviation. In the Air Navigation Section, Lieut.-Colonel E. Gold read a paper on the computation of an index figure of fitness for flying at an aerodrome or along an air route to be used for statistical purposes, while Baron de Dorlodot contributed a note on the meteorological organisation for an air route. Most of the meteorological papers, however, were read in the Scientific Section. Commandant Jaumotte, Director of the Royal Meteorological Institute of Belgium, described the new meteorograph, which he has recently designed for obtaining upper air temperatures and humidities from aeroplanes, while Dr. Cannegieter of the Meteorological Institute, De Bilt, gave an account of a method which had been tried in Holland, of fixing a meteorograph inside the wing of an aeroplane in order to avoid the present disadvantage, from the aviator's point of view, of the exposure of a large instrument on some external portion of the machine. Ventilation is effected by series of holes suitably arranged in the upper and lower surfaces of the wing. Other contributions included a paper by Captain F. Entwistle on meteorology in relation to the selection of aerodrome sites, an account by Commandant Jaumotte of a method of obtaining stereoscopic cloud photographs from an aeroplane, and a paper by Messrs. Gregg and Zandt, the former of the United States Weather Bureau, on the effect of wind on the flight of an aeroplane as deduced from statistics of one year's record of the air mail service between New York and San Francisco.

In addition to the meetings of the different sections for the discussion of papers, visits were arranged to the technical aeronautical workshops at Seraing, near Liège, to the civil aerodrome at Evere, near Brussels, and to the Meteorological Institute at Uccle. The social side was by no means neglected, a large number of members attending, by invitation, an excellent performance, on Friday evening, of "Madame Butterfly," at the Théatre Royale, while earlier in the day, by courtesy of M. Max, the Burgomaster, an opportunity was afforded of visiting the beautiful and historic Hotel de Ville.

The final meeting of the full Congress was held on Saturday afternoon, when the work of the various sections was reviewed and certain resolutions which had been proposed in the course of the week were ratified. A banquet was given to members of the Congress on Saturday evening, concluding with speeches from Sir Samual Hoare, M. Laurent Eynac, Signor Mercanti and others.

One could not but be struck with the excellent organisation, under the direction of the Secretary, Commandant Desoil, which ensured the smooth working of the Congress from start to finish.

This, combined with a week of brilliantly fine weather, helped to make the Congress a memorable occasion for those who were fortunate enough to participate in it.

F. E.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1925.

Unit: one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays)

Averages for Readings

		July	Aug.	Sept.
Cloudless days :—				
Number of readings	n	8	7	6
Radiation from sky in zenith ...	π I	576	570	491
Total radiation from sky ...	J	591	618	523
Total radiation from horizontal black surface on earth ...	X	786	787	721
Net radiation from earth ...	X—J	195	169	198

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

Cloudless days :—				
Number of readings	n_0	0	0	2
Radiation from sky in zenith ...	πI_0	—	—	46
Total radiation from sky ...	J_0	—	—	52
Cloudy days :—				
Number of readings	n_1	0	3	4
Radiation from sky in zenith ...	πI_1	—	171	169
Total radiation from sky ...	J_1	—	159	143

Unit for I = gramme calorie per day per steradian per square centimetre.

Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

New Forecasting Service in Italy

BY a recent decree published by the Italian Commissariat for Aeronautics, the Forecasting Section of the Central Meteorological Office and the Aerological Section of the Higher Directorate

of Aeronautical Engineering will be combined into one department, dependent on the Commissariat and to be known as the "Weather Forecasts Department," with its headquarters at the Central Meteorological and Geophysical Office, Rome. The new department will collect observations and publish daily weather bulletins, carry out experiments with regard to meteorology as applied to aeronautics, test instruments for weather forecasting, and organize meteorological experiments with aircraft.

Obituary

Mr. F. J. Brodie.—The death of Mr. F. J. Brodie, which was briefly reported in the September number of the *Meteorological Magazine*, removes another of the old staff who for so many years carried on the work of the Meteorological Office. Brodie entered the Office as a boy clerk in 1869, during the second year of Dr. R. H. Scott's directorship, and about four years after the death of Admiral Fitzroy. I believe I am correct in saying that throughout his official career he was associated with what used to be called the Telegraphic Branch, which has now become the Forecast Division. For many years he and the late Frederick Gaster were the working heads of the division. Practically every forecast that was issued was prepared by one or other of them, and, as far as I have been able to find out, there was no margin for sickness or leave. If either of the seniors was away, the other just carried on, with such assistance as he could get from any of the junior staff. When I entered the Office in 1902, Gaster's health was beginning to fail, and Mr. R. Sargeant had just been put on the regular roster for forecast duty. The work of the division was increasing rapidly both in amount and in strenuousness, and, with the change in the hour of morning observations from 8 a.m. to 7 a.m. looming in sight, it was necessary to further strengthen the forecast staff. Mr. H. Harries was therefore transferred from the Marine Division, and presently, after a lengthy course at forecast checking under Gaster and Brodie's supervision—then our recognized method of training forecasters—I was also allowed to try my 'prentice hand, and we had thus a team of four forecasters.

After a year or two, I was transferred to other work, and I came in contact with Brodie but rarely, but in 1910 the Office was transferred from 63, Victoria Street, to South Kensington, and at the same time a superintendentship was attached to the Forecast Division. I was appointed to the post and Brodie thus became my principal assistant. No doubt the consciousness that the work was increasing rapidly—the advent of wireless telegraphy was changing the complexion of routine forecasting—made the assistance of a younger man in some ways desirable, but the position cannot have been an easy one for a man who had

for many years been the head of his department. I therefore welcome this opportunity of placing on record my gratitude for the manner in which he received me into the division and for the unfailing courtesy which he always extended to me. A smaller man would have found many opportunities for making things difficult. As a forecaster Brodie had many excellent qualities. The Office forecasts often were, and probably still are, made the subject for jest. It is no easy task to compress a description of a day's weather over a district into a sixpenny telegram, but Brodie's terseness of style came to his aid and he generally accomplished the task extremely well. Rarely did his forecasts read like an utterance of the Delphic oracle, and then only when the weather was of so indecisive a type that precision was impossible. Forecasting in his day was practically entirely empirical, but by long experience he had developed a kind of intuition of coming changes. I sometimes challenged him for his reasons for issuing what appeared to me a risky gale warning, but all I could extract was: "Oh, I think it is going to blow," and as a general rule it did, but of course there were exceptions. When that happened, his comment was: "Well, as Gaster used to say, I'd do it again next time." In such cases he worked by no formulated or formulable rule, all he had to go upon was a recollection stored away somewhere at the back of his brain of a previous map showing similar characteristics.

Apart from forecasting, he took a keen interest in meteorology. For his own satisfaction he prepared summaries of the observations which he had to handle in the course of his official duties, and from time to time these resulted in valuable statistical papers. His papers on the prevalence of gales on the coasts of the British Isles for the 30 years, 1871-1900, in the *Quarterly Journal of the Royal Meteorological Society*, still form perhaps the most complete statistical summary of the subject that we have, while in a paper on the incidence of bright sunshine over the United Kingdom during the 30 years, 1881-1910, which also appeared in the *Journal*, he anticipated work which the Office subsequently did in the *Book of Normals*. He was particularly interested in the statistics of fog for London and kept a record of his own in which he combined the results for the various London stations in a way which he hoped might eliminate the personal equation and variations in the standard by which different observers judge a fog. Even with the modern Visibility Scale it may be doubted whether absolute homogeneity is attained, but the older statistics are manifestly deficient in this respect. Brodie's series, also published in the *Journal*, probably comes nearer than most to attaining the desired end.

R. G. K. LEMPFERT.

Mr. J. Ellis Mace. The death occurred, on September 19th,

of Mr. J. Ellis Mace in his 78th year. As a lad he set up a rain-gauge at Tenterden in Kent and maintained the records continuously from June, 1863, until a few days before his death. He had thus more than 62 years' observations to his credit, a record which is only exceeded by that of the veteran Mr. W. S. Clark, of Street, Somerset, whose records appeared in the first volume of *English Rainfall*, that for 1860. Mr. Mace's records have appeared for many years in the rainfall tables in this magazine and they have also been utilized in the preparation of a series of rainfall normals recently published as Section V. of the *Book of Normals for the British Isles*. The study of the weather remained a subject of absorbing interest to him throughout his life; only a fortnight before his death, when forwarding his records for August, he added a series of notes on the weather on individual days during the month and the effects on harvest operations. H. E. C.

We regret to announce the death, on October 19th, of Mr. W. R. C. Chillman, Office Keeper for ten years in the Meteorological Office, South Kensington.

We regret to learn that Professor A. A. Friedmann, who has been Director of the Central Geophysical Observatory of Russia since February 5th, 1925, died on September 16th, at the age of 37, after a short, painful illness.

We also regret to learn of the death on August 17th, at Buenos Aires, at the age of 45 years, of Dr. A. Merz, chief scientist of the German Atlantic Expedition, 1925, Director of the Oceanographical Institute and Museum at Berlin, and Professor of Geography in the University.

News in Brief

Captain W. Ellery, Principal Examiner of Masters and Mates, has been nominated by the Board of Trade to succeed the late Captain Warden as their representative on the Meteorological Committee.

At the annual statutory meeting of the Royal Society of Edinburgh, held on Monday, October 26th, Dr. A. Crichton Mitchell, formerly Superintendent of the Meteorological Office, Edinburgh, was appointed Curator of the Library and Museum of this society.

A mass meeting of Civil Servants will be held in the Royal Albert Hall on November 17th. The object of the meeting is to enlighten public opinion as to the actual conditions of the Service and to protest against unfair criticism.

Erratum

October, 1925, p. 224, line 35, *for* " somewhat below normal " *read* " somewhat above normal."

The Weather of October, 1925

APART from some rather cold weather just before the middle of the month, October, 1925, was predominatingly mild, the first half of the month was dry and sunny, the second half unsettled windy and wet. During the first week high pressure over the British Isles was associated with local mist or fog and high temperatures; maxima exceeded 70° F. in several instances, and reached 75° F. at Cullompton on the 4th, while minima varying between 55° F. and 60° F. were registered in several places. By the 8th, the winds had become north or north-east generally, and this change was accompanied by a marked drop in temperature. Thick fog developed in most parts of England and Ireland on the morning of the 11th, but by the 12th the anticyclone which had been over the British Isles withdrew a little westwards again and a definite northerly wind current set in over the eastern districts. Snow, sleet and hail showers were experienced in Scotland and east England during the next few days, and "snow lying" to a depth of 1 in. was reported from Balmoral on the 14th and 17th. A thunderstorm occurred at Aberdeen on the 14th, and at Elgin on the 17th. The lowest temperatures of the month were recorded at this period, a screen minimum of 17° F. being reported from West Linton (Peebles) on the 16th, and a grass minimum of 13° F. from Rhayader (Radnor) on the 14th. At Ross-on-Wye, 10·0 hrs. bright sunshine were recorded on the 14th, the latest date on which 10 hrs. has ever been registered at this station. So far, precipitation, except in a few districts, had been scanty, but by the 15th depressions were beginning to approach from the Atlantic and within a few days mild cyclonic conditions prevailed with high winds and heavy rain at times, which continued until the end of the month. Gales were experienced on some parts of the coasts on the 22nd-23rd, 26th-27th, 29th and 31st. Amongst the heaviest falls of rain were 57 mm. (2·23 in.) and 76 mm. (2·98 in.) at Tynywaun (Glamorgan) on the 19th and 20th respectively, 52 mm. (2·05 in.) at Holne (Devon) on the 22nd, 138 mm. (5·425 in.) at Lake Llydaw, Snowdon, on the 25th, and 47 mm. (1·85 in.) at Seskin (Waterford) on the 29th. Some of the nights were unusually warm for the time of year, especially on the 21st, when the temperature did not fall below 60° F. at Kew. Total rainfall for the month varied considerably, being 156 per cent. of the normal at Dolaucothy (Carmarthen) and 42 per cent. at North Berwick (Haddington).

Pressure was below normal over Scandinavia, the British Isles and the greater part of the North Atlantic, the deficit amounting to 9 mb. at Vardo (Norway) and St. Johns (Newfoundland). Over Iceland and a region extending from the English Channel to Prague and Algiers, pressure was above normal. Temperature

was high over southern and western Europe, but nearly 4° F. below normal in parts of Scandinavia. Rainfall was generally below normal, the deficit being 68 mm. at Zürich. At the beginning of the month a severe storm occurred in the Persian Gulf, when 1,000 lives and 40 boats were lost, and on the 4th, gales in the Gulf of Bothnia resulted in the loss of a Finnish torpedo boat. Owing to the heavy rains early in the month, the railway bridge over the Penzio, a few miles from Badolato, was swept away and a serious railway accident occurred. Several other bridges fell later. Snowfalls were reported from Westphalia about the 20th.

Five people were killed in a gale which swept over New York City for sixteen hours on the 10th. On that day, temperature did not rise above 40° F. in the city, and the lakes throughout New England were frozen thick enough for skating. A tornado originating in Texas reached its greatest violence in Alabama on the 25th, and severe gales occurred in most of the eastern states on that day. From the 19th to the end of the month, gales were continuously reported by ships from one or other parts of the North Atlantic, force 10 (59 m.p.h.) being recorded by a Scandinavian ship at 1 h. on the 20th in 55° N. 31° W, and by the "Caronia" at 13 h. on the 26th in 51° N, 15° W. Five inches of rain fell in Calcutta on the 15th, one of the heaviest downpours recorded in that city for October. The rainfall of Australia was generally about 25 mm. (1 in.) below normal.

In Africa, heavy rains in Morocco on the 12th and 13th put an end for a time to military operations, and in the Kalahari districts, Professor Schwarz, head of the Kalahari Survey Expedition, was forced to return in a dug-out canoe on the Botletle River to Pretoria on account of the floods which are the results of the heavy rains of last season. It is said to be 25 years since there was sufficient water in the Botletle River even for a dug-out canoe, and Lake Ngami has turned from a swamp into a lake about 30 miles wide.

The special message from Brazil states that the rainfall was irregular in the northern districts, being 6·5 mm. under the normal, plentiful in the central districts, where it was 15·6 mm. above the normal, and abundant in the southern districts, with 103·7 mm. above the normal. The weather was generally favourable to crops and vegetables, but temperature was abnormally low in the south and parts of the central districts. At Rio de Janeiro pressure was 0·6 mb. above normal, and temperature 2·5° F. below normal.

Rainfall October, 1925—General Distribution

England and Wales ..	103	per cent. of the average 1881-1915.
Scotland	98	
Ireland	105	
British Isles	102	

Rainfall: October, 1925: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square.....	3·09	79	117	*War.*	Birminghm, Edgbaston	3·72	94	134
Sur .	Reigate, Hartswood...	3·52	89	112	*Leics*	Thornton Reservoir ..	3·45	88	123
Kent.	Tenterden, Ashenden..	4·19	106	120	,, .	Belvoir Castle.....	2·72	69	101
,, .	Folkestone, Boro. San.	3·31	84	...	*Rut .*	Ridlington.....	3·12	79	...
,, .	Broadstairs, St. Peter's	...	..	...	*Linc.*	Boston, Skirbeck	2·35	60	86
,, .	Sevenoaks, Speldhurst.	4·50	114	...	,, .	Lincoln, Sessions House	2·23	57	87
Sus .	Patching Farm.....	3·85	98	97	,, .	Skegness, Estate Office.	1·97	50	72
,, .	Brighton, Old Steyne .	3·93	100	104	,, .	Louth, Westgate	2·50	63	77
,, .	Tottingworth Park....	5·30	135	128	,, .	Brigg	2·37	60	79
Hants	Ventnor, Roy. Nat. Hos.	3·72	95	95	*Notts.*	Worksop, Hodsock....	2·51	64	95
,, .	Fordingbridge, Oaklnds	4·57	116	110	*Derby*	Mickleover, Clyde Ho..	3·51	89	130
,, .	Ovington Rectory	3·66	93	90	,, .	Buxton, Devon. Hos...	6·56	167	134
,, .	Sherborne St. John Rec.	3·88	99	110	*Ches.*	Runcorn, Weston Pt...	4·49	114	131
Berks	Wellington College...	1·96	50	60	,, ..	Nantwich, Dorfold Hall	3·39	86	...
,, .	Newbury, Greenham..	4·35	111	124	*Lancs*	Manchester, Whit. Pk.	4·28	109	130
Herts.	Benington House	2·92	74	107	,, ..	Stonyhurst College....	5·57	141	124
Bucks	High Wycombe	3·57	91	114	,, ..	Southport, Hesketh....	4·19	106	118
Oxf..	Oxford, Mag. College..	2·41	61	86	,, ..	Lancaster, Strathspey.	5·66	144	...
Nor .	Pitsford, Sedgebrook..	3·32	84	124	*Yorks*	Sedbergh, Akay	7·17	182	144
,, .	Eye, Northolm.....	2·42	61	...	,, .	Wath-upon-Dearne ...	2·52	64	91
Beds.	Woburn, Crawley Mill.	2·99	76	110	,, .	Bradford, Lister Pk...	3·65	93	105
Cam.	Cambridge, Bot. Gdns.	2·51	64	106	,, .	Wetherby, Ribston H..	3·04	77	101
Essex	Chelmsford, County Lab	2·67	68	109	,, .	Hull, Pearson Park ...	2·39	61	80
,, .	Lexden, Hill House...	2·65	67	...	,, .	Holme-on-Spalding ...	2·71	69	...
Suff .	Hawkedon Rectory ...	2·79	71	103	,, .	West Witton, Ivy Ho..	3·80	97	...
,, .	Haughley House.....	1·94	49	...	,, .	Felixkirk, Mt. St. John	2·60	66	90
Norf.	Beccles, Geldeston....	1·54	39	55	,, .	Pickering, Hungate ...	2·55	65	...
,, .	Norwich, Eaton	1·70	43	54	,, .	Scarborough.....	1·61	41	51
,, .	Blakeney	2·02	51	77	,, .	Middlesbrough	2·53	64	84
,, .	Swaffham	2·27	58	79	,, .	Baldersdale, Hury Res.	3·73	95	95
Wilts.	Devizes, Highclere....	3·21	81	103	*Durh.*	Ushaw College	2·65	67	77
,, .	Bishops Cannings	3·00	76	90	*Nor .*	Newcastle, Town Moor.	1·60	41	50
Dor .	Evershot, Melbury Ho.	5·63	143	122	,, .	Bellingham, Highgreen	2·87	73	...
,, .	Weymouth, Westham..	...	..	...	,, .	Lilburn Tower Gdns...	2·05	52	...
,, .	Shaftesbury, Abbey Ho.	...	..	...	*Cumb*	Geltsdale.....	3·44	87	...
Devon	Plymouth, The Hoe...	3·50	89	89	,, .	Carlisle, Scaleby Hall .	3·86	98	116
,, .	Polapit Tamar	4·42	112	92	,, .	Seathwaite M.....	16·30	414	136
,, .	Ashburton, Druid Ho..	6·67	169	110	*Glam.*	Cardiff, Ely P. Stn.....	6·00	152	125
,, .	Cullompton	3 58	91	87	,, .	Treherbert, Tynywaun	13·50	343	...
,, .	Sidmouth, Sidmount ..	3·26	83	88	*Carm*	Carmarthen Friary....	7·21	183	126
,, .	Filleigh, Castle Hill ...	4·67	119	...	,, .	Llanwrda, Dolaucothy.	9·90	251	156
,, .	Barnstaple, N.Dev.Ath.	4·59	117	101	*Pemb*	Haverfordwest, School	6·60	168	122
Corn.	Redruth, Trewirgie ...	4·90	125	93	*Card.*	Gogerddan.....	4·79	122	91
,, .	Penzance, Morrab Gdn.	3·70	94	79	,, .	Cardigan, County Sch. .	5·17	131	...
,, .	St. Austell, Trevarna..	4·51	115	86	*Brec .*	Crickhowell, Talymaes	6·00	152	...
Soms	Chewton Mendip	4·79	122	99	*Rad .*	Birm. W. W. Tyrmynydd	6·92	176	105
,, .	Street, Hind Hayes ...	2·80	71	...	*Mont.*	Lake Vyrnwy	7·23	184	127
Glos..	Clifton College	3·80	97	101	*Denb.*	Llangynhafal	3·74	95	...
,, .	Cirencester	3·50	89	103	*Mer .*	Dolgelly, Bryntirion..	6·86	174	113
Here.	Ross, Birchlea	3·04	77	92	*Carn.*	Llandudno	3·85	98	107
,, .	Ledbury, Underdown.	2·97	75	96	,, .	Snowdon, L. Llydaw 9	23·23	590	...
Salop	Church Stretton.....	4·12	105	114	*Ang .*	Holyhead, Salt Island.	3·87	98	97
,, .	Shifnal, Hatton Grange	3·44	87	122	,, .	Lligwy	4·78	121	...
Staff.	Tean, The Heath Ho...	4·72	120	146	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	2·92	74	109		Douglas, Boro' Cem...	4·40	112	95
,, .	Blockley, Upton Wold.	3·67	93	112	*Guernsey*				
War.	Farnborough.....	3·92	100	124		St. Peter P't, Grange Rd	3·42	87	76

Rainfall: October, 1925: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	3·49	89	96	*Suth.*	Loch More, Achfary...	9·62	244	123
,, .	Pt. William, Monreith .	3·88	99	...	*Caith*	Wick	2·91	74	98
Kirk.	Carsphairn, Shiel.	9·78	248	...	*Ork .*	Pomona, Deerness	4·40	112	116
,, .	Dumfries, Cargen.....	6·00	152	138	*Shet .*	Lerwick	4·72	120	119
Dum	Drumlanrig	5·65	143	131					
Roxb	Branxholme	3·40	86	105	*Cork.*	Caheragh Rectory	6·10	155	...
Selk .	Ettrick Manse.....	6·67	169	...	,, ..	Dunmanway Rectory.	6·80	173	113
Berk.	Marchmont House	2·17	55	57	,, ..	Ballinacurra	4·79	121	118
Hadd	North Berwick Res....	1·24	31	42	,, ..	Glanmire, Lota Lo. ...	5·37	136	129
Midl	Edinburgh, Roy. Obs..	1·83	47	71	*Kerry*	Valencia Obsy.	4·59	117	82
Lan .	Biggar	3·54	90	118	,, .	Gearahameen	10·30	262	...
Ayr .	Kilmarnock, Agric. C..	3·60	91	103	,, .	Killarney Asylum.....	6·65	169	124
,, .	Girvan, Pinmore.....	6·18	157	124	,, .	Darrynane Abbey	5·20	132	103
Renf.	Glasgow, Queen's Pk..	2·90	74	89	*Wat .*	Waterford, Brook Lo..	4·32	110	110
,, .	Greenock, Prospect H..	6·24	159	116	*Tip .*	Nenagh, Cas. Lough...	3·57	91	105
Bute.	Rothesay, Ardencraig.	5·32	135	121	,, .	Tipperary	4·42	112	...
,, .	Dougarie Lodge	4·21	107	...	,, .	Cashel, Ballinamona ..	3·81	97	106
Arg .	Ardgour House	7·69	195	...	*Lim .*	Foynes, Coolnanes	3·87	98	104
,, .	Manse of Glenorchy..	7·50	191	...	,, .	Castleconnell Rec.	4·23	107	...
,, .	Oban	4·27	109	...	*Clare*	Inagh, Mount Callan ..	6·57	167	...
,, .	Poltalloch	5·71	145	115	,, .	Broadford, Hurdlest'n.	4·86	123	...
,, .	Inveraray Castle.....	6·37	162	90	*Wexf*	Newtownbarry	4·32	110	...
,, .	Islay, Eallabus.....	5·13	130	118	,, .	Gorey, Courtown Ho...	4·97	126	140
,, .	Mull, Benmore	11·60	295	...	*Kilk.*	Kilkenny Castle.....	3·58	91	114
Kinr.	Loch Leven Sluice	2·93	74	85	*Wic .*	Rathnew, Clonmannon	4·55	116	...
Perth	Loch Dhu	8·35	212	117	*Carl .*	Hacketstown Rectory .	3·83	97	101
,, ..	Balquhidder, Stronvar.	7·03	179	103	*QCo..*	Blandsfort House.....	3·37	86	96
,, ..	Crieff, Strathearn Hyd.	4·11	104	105	,,	Mountmellick	3·98	101	...
,, ..	Blair Castle Gardens ..	3·63	92	117	*KCo.*	Birr Castle.....	2·17	55	75
,, .	Coupar Angus School..	3·16	80	111	*Dubl..*	Dublin, FitzWm. Sq...	2·41	61	90
Forf.	Dundee, E. Necropolis.	2·36	60	89	,, .	Balbriggan, Ardgillan .	2·58	65	95
,, .	Pearsie House.....	3·81	97	...	*Me'th*	Drogheda, Mornington	2·39	61	...
,, .	Montrose, Sunnyside..	2·22	56	80	,, .	Kells, Headfort.....	3·45	88	103
Aber.	Braemar, Bank	3·33	85	89	*W.M*	Mullingar, Belvedere .	3·79	96	121
,, .	Logie Coldstone Sch. ..	1·96	50	60	*Long*	Castle Forbes Gdns....	3·84	97	118
,, .	Aberdeen, King's Coll..	2·68	68	89	*Gal .*	Ballynahinch Castle ..	6·29	160	105
,, .	Fyvie Castle	2·68	68	...	*Mayo*	Mallaranny.....	6·02	153	...
Mor .	Gordon Castle.....	2·67	68	84	,, .	Westport House.....	4·54	115	101
,,	Grantown-on-Spey....	2·51	64	84	,, .	Delphi Lodge	9·89	251	...
Na .	Nairn, Delnies.....	1·68	43	71	*Sligo*	Markree Obsy.	3·83	97	94
Inv..	Ben Alder Lodge	3·87	98	...	*Cav'n*	Belturbet, Cloverhill..	2·91	74	100
,, .	Kingussie, The Birches	2·06	52	...	*Ferm*	Enniskillen, Portora ..	3·71	94	...
,, .	Loch Quoich, Loan....	...	..	...	*Arm.*	Armagh Obsy.	2·46	63	90
,, .	Glenquoich	...	..	...	*Down*	Warrenpoint	3·32	84	...
,, .	Inverness, Culduthel R.	1·84	47	...	,, .	Seaforde	4·76	121	134
,, .	Arisaig, Faire-na-Squir	3·75	95	...	,, .	Donaghadee, C. Stn...	2·88	73	100
,, .	Fort William.....	6·66	169	95	,, .	Banbridge, Milltown .	2·65	67	96
,, .	Skye, Dunvegan.....	6·35	161	...	*Antr.*	Belfast, Cavehill Rd. .	3·84	97	...
,, .	Barra, Castlebay	2·29	58	...	,, .	Glenarm Castle.....	3·97	101	...
R&C	Alness, Ardross Cas. ..	2·34	59	61	,, .	Ballymena, Harryville	3·57	91	97
,, .	Ullapool.....	4·86	124	...	*Lon .*	Londonderry, Creggan	3·08	78	84
,, .	Torridon, Bendamph..	6·57	167	82	*Tyr .*	Donaghmore	3·33	85	...
,, .	Achnashellach	7·34	186	...	,, .	Omagh, Edenfel	...	..	...
,, .	Stornoway	4·73	120	91	*Don .*	Malin Head	2·56	65	87
Suth.	Lairg	3·19	81	...	,, .	Rathmullen.....	3·52	89	...
,, .	Tongue Manse.....	4·35	111	104	,, .	Dunfanaghy	...	.	...
,, .	Melvich School.....	4·07	103	111	,, .	Killybegs, Rockmount.	6·29	160	112

Climatological Table for the British Empire, May, 1925

STATIONS	PRESSURE		TEMPERATURE						Mean Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values							Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
			Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal								
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1009·5	— 6·4	77	38	63·9	47·1	55·5	+ 2·1	49·5	85	6·5	48	+ 4	18	6·4	41
Gibraltar	1016·6	+ 0·5	77	53	71·3	56·7	64·0	— 1·5	55·0	74	3·6	8	— 36	2	...	...
Malta	1012·2	— 2·8	75	53	67·9	59·9	63·9	— 2·0	59·2	78	5·8	39	+ 29	4	7·4	53
Sierra Leone	1011·8	+ 0·1	94	69	89·9	73·2	81·5	— 0·5	76·7	77	4·4	144	—139	13	...	...
Lagos, Nigeria	1009·2	— 1·8	91	72	88·3	77·0	82·7	+ 1·5	78·3	80	7·8	309	+ 46	18	...	...
Kaduna, Nigeria	1012·5	— 0·6	94	...	89·0	...	...	...	72·4	71	1·6	128	— 23	15	...	...
Zomba, Nyasaland	1014·5	— 0·9	83	49	75·1	57·1	66·1	+ 0·4	...	88	6·1	40	+ 13	9	...	...
Salisbury, Rhodesia	1015·6	— 1·4	79	41	72·5	49·3	60·9	+ 0·4	54·9	67	2·3	21	+ 9	4	8·7	77
Cape Town	1018·2	+ 0·3	86	41	70·6	51·0	60·8	+ 1·8	52·4	85	4·0	37	— 56	7	...	...
Johannesburg	1019·4	— 0·9	69	32	61·0	43·4	52·2	— 2·2	44·8	64	3·0	38	+ 20	6	7·6	70
Mauritius	1016·2	— 0·2	83	63	80·4	67·3	73·9	+ 1·3	72·3	81	5·1	57	— 20	19	8·3	75
Bloemfontein	...	...	74	31	63·4	38·5	50·9	— 1·8	44·0	86	3·3	59	+ 29	10	...	...
Calcutta, Alipore Obsy.	1002·7	— 0·8	103	73	95·3	78·8	87·1	+ 1·1	79·5	81	5·1	119	— 27	7*	...	...
Bombay	1006·5	— 0·9	93	77	92·0	81·8	86·9	+ 1·0	78·3	71	4·8	70	+ 56	3*	...	...
Madras	1005·2	— 0·2	104	71	97·0	79·7	88·3	— 1·6	78·0	67	4·9	103	+ 76	4*	...	...
Colombo, Ceylon	1008·5	— 0·1	89	75	87·6	77·7	82·7	+ 0·2	79·1	74	7·8	204	—125	29	6·8	55
Hong Kong	1007·7	— 1·7	89	65	82·3	74·1	78·2	+ 0·8	74·0	79	8·7	66	—229	13	5·5	42
Sandakan	...	...	91	74	88·8	76·6	82·7	+ 0·1	77·1	79	...	115	— 37	9	...	...
Sydney	1015·0	— 3·6	75	49	67·0	54·2	60·6	+ 2·0	56·0	79	5·8	509	+378	19	4·3	41
Melbourne	1017·5	— 2·0	74	37	61·3	48·1	54·7	+ 0·6	50·8	87	8·6	37	— 18	9	2·6	26
Adelaide	1017·6	— 2·5	74	41	64·5	50·1	57·3	— 0·5	51·9	71	6·4	78	+ 9	17	4·4	43
Perth, W. Australia	1016·3	— 2·2	81	43	69·0	53·2	61·1	+ 0·5	55·7	73	5·5	126	+ 2	19	5·6	54
Coolgardie	1017·3	— 2·5	77	41	65·7	48·4	57·1	— 0·5	51·2	71	6·4	15	— 20	4	...	...
Brisbane	1014·2	— 4·7	78	47	71·7	55·9	63·8	— 0·6	58·1	72	5·3	151	+ 78	13	6·2	58
Hobart, Tasmania	1020·6	+ 5·0	65	35	56·2	45·6	50·9	+ 0·5	46·4	83	6·8	87	+ 40	18	3·5	36
Wellington, N.Z.	1019·3	+ 4·1	69	36	58·2	47·2	52·7	— 0·2	49·4	78	7·2	160	+ 39	17	3·6	37
Suva, Fiji	1011·0	— 1·8	86	69	83·2	73·0	78·1	+ 1·6	74·8	82	6·3	253	— 5	22	...	...
Apia, Samoa	1011·0	— 0·1	87	69	83·9	73·5	78·7	+ 0·3	76·2	81	6·8	599	+459	21	4·5	39
Kingston, Jamaica	1012·8	— 0·3	89	68	87·3	71·9	79·6	— 0·1	72·2	78	4·6	80	— 30	4	...	...
Grenada, W.I.	1014·2	+ 1·6	88	72	85·6	74·7	80·1	+ 0·6	74.5	70	4·8	26	— 92	10	...	...
Toronto	1013·9	— 0·9	81	30	60·7	41·0	50·9	— 1·8	44·7	70	4·9	33	— 43	10	6·9	47
Winnipeg	1015·3	+ 1·0	83	22	63·5	38·2	50·9	— 0·7	...	...	4·5	7	— 50	7	6·9	45
St. John, N.B.	1012·2	— 1·8	63	35	54·1	39·9	47·0	— 0·7	43·0	74	6·4	44	— 50	12	6·6	44
Victoria, B.C.	1015·5	— 0·9	84	42	63·2	47·4	55·3	+ 2·2	50·6†	75†	6·0†	14	— 19	5	9·5	63

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.
† Observations of wet bulb, relative humidity and cloud amount refer to 9h. from May, 1925.

M.O. 278.

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An Outstanding Problem of Meteorology

By D. BRUNT, M.A.

AMONG the outstanding problems of physical meteorology none is more puzzling than that offered by the phenomena grouped under the name of "convection." In the *Meteorological Glossary* under the heading of convection, we find the following: "In general, if a part of a fluid, whether liquid or gaseous, is warmed, its volume is increased, and the weight per unit of volume is less than before. The warmed part therefore rises, and its place is taken by fresh fluid which is warmed in turn." This statement in essentially the same form is to be found in any text-book of meteorology. From this statement is developed the law of statical equilibrium in the vertical, which states that a mass of air is stable if the potential temperature increases with height, and unstable if the potential temperature diminishes with height. Thus the limiting condition between stability and instability is that potential temperature should remain constant at all heights, or, in terms of temperature, that the lapse rate should equal the adiabatic. A lapse rate less than the adiabatic should give a stable atmosphere, and a lapse rate greater than the adiabatic an unstable one.

The derivation of these conditions of stability from the assumptions made, is simple and straightforward, and offers no difficulty even to the humblest mathematician. Difficulties only begin to arise when we compare the theory with the actual

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phenomena. We then find, not that air rises as soon as it is heated, but that on the contrary air can be heated in its lowest layers until the lapse rate may be twenty or even thirty times the dry adiabatic, and that this state can persist for considerable periods of time, even in air which is not still. We are thus forced to the conclusion that convection, such as we have been led to expect, does not occur as readily in the atmosphere as the simple theory demands.

There is a further complication too. We should expect that if, starting with a lapse rate greatly in excess of the adiabatic, there was a violent upheaval of the conditions, due to the ascent of air from the ground, the result should be to bring down to the ground the air with the lowest potential temperature, and that the final result should be to yield a system with potential temperature increasing or constant with height. But there is a suspicion, partly based on observation, that the result of the upheaval is frequently to leave the system with potential temperature decreasing with height, and therefore still unstable, judging stability by the criterion of the first paragraph.

It is thus clear that the phenomena observed in the atmosphere (and they can be observed on any sunny afternoon), do not fit in with the simple theory of the textbooks. The question which naturally arises is—what is wrong with the theory? It can only be wrong in its assumptions. Now at first sight it might appear that the ordinary textbook theory is devoid of all assumptions. The atmosphere, however, is a compressible viscous fluid, which has a definite power of absorption and radiation, and we readily find that the theory of stability usually given makes no allowance for viscosity, or for radiation and absorption. The present writer is of opinion that the neglect of these factors is at the root of the trouble, and that the physical basis of stability in the atmosphere should follow the lines discussed by the late Lord Rayleigh in his treatment of convection in an incompressible conducting fluid*. An outline in brief of the underlying ideas involved in the application of Rayleigh's method to the atmosphere was given by the present writer, in this magazine for February, 1925, and in *Nature* for February 28th, 1925. The problem has not been solved in the meantime, and the attention of meteorologists is invited to the points of difficulty involved.

It appears to be fairly certain that the effects of radiation and absorption in damping out small irregularities of temperature must be an important factor in the maintenance of the very large lapse rates which are so frequently observed. The importance of radiation in the lower layers of the atmosphere was very strongly emphasised in a recent paper read by Prof. Chapman before the

* See *Phil. Mag. XXXII.* (1916), 529.

Royal Meteorological Society. In that paper Chapman explained the fact that the temperature at the top of the Eiffel Tower begins to rise during the morning long before the lapse rate has reached the adiabatic, by ascribing to radiation and absorption a far more important rôle than has hitherto been assigned to them. The weakness of the treatment given in that paper lay in the rather uncertain nature of the observations discussed, and it is highly desirable that reliable observations of temperature at different heights should be obtained by means of delicate self-recording instruments. Chapman's paper marks a very definite advance in that it shows that convection and turbulence do not in themselves account for the phenomena observed, and it strengthens one's feeling that the effects of radiation and absorption are very closely bound up with the effects of convective turbulence. If the effects of these phenomena could be separated, we should then have a clearer idea of the time scale of radiation effects. The time scale of radiation effects is a matter concerning which our knowledge is very hazy. The present writer, at any rate, knows of no clear statement of it. It does not of course follow automatically that the time scale of radiation effects would be the same at the tropopause as it is at the ground, but it might be possible to extrapolate without violation to commonsense.

The greatest of all problems in meteorology is closely bound up with the time scale of radiation effects—the greatest problem referred to being the maintenance of the general circulation of the atmosphere. It can be shown that the amount of energy of the general circulation which is dissipated by turbulence could be replaced if 2 per cent. of the incoming solar radiation were converted into kinetic energy. It has been suggested by Sir Napier Shaw* that the transference of solar energy into kinetic energy is in part brought about through the ascent of warm humid air within the tropics, the ascended air moving polewards in the upper air, but on account of cooling by radiation descending in middle latitudes, after which it completes a cycle by moving equatorwards over the earth's surface. To this it has been objected that the horizontal stratification of the atmosphere is such as to oppose descent of air from above. But it appears possible that the poleward moving air is cooled by radiation sufficiently rapidly to be able to descend, being, as to temperature, a normal sample of the air at each successive level during its descent. To answer the question raised here, it is thus necessary to determine the time scale of radiation effects.

It is customary to think of ascending currents as being much more violent than descending currents, the latter being spread over a wider horizontal area, and therefore demanding smaller

* Dictionary of Applied Physics, Vol. III. p. 82.

velocities in the vertical. Cases have been observed, however, of the descent of artificial clouds at a rate of the order of 1,000 feet per minute, or about 5 metres per second. It would be illuminating to have a mental picture of the physical or dynamical processes involved in these large descending currents.

There is another problem of meteorology which may be closely associated with convection, namely, the initial stage of formation of a cyclonic centre. The diagrams given by J. Bjerknes and Solberg to illustrate the stages of development of a cyclone show as the initial stage the bulging of the warm air into the cold air. This raises a rather intriguing point, in that the process suggested appears to require the pushing back of the cold air, and therefore a slight increase of potential energy, which should involve a diminution of kinetic energy. But the initial stage of development of the cyclone surely involves an increase of kinetic energy. The present writer has always found this a puzzling difficulty. It may be that the solution of the difficulty lies in the assumption of a thermal centre of convection for the cyclone. The later stages of development of the cyclone do not present quite the same difficulty, since the interaction of the nascent cyclone and it surroundings would bring into play forces of the right kind to keep the cyclone in being, and to make it deepen.

The sole aim of the writer of the present note is to state as clearly as possible a difficulty which must have occurred to any serious student of meteorology—a difficulty which, moreover, concerns two of the most fundamental factors in meteorology, convection and radiation. It is certain that the solution of the problems stated above would throw light on many obscure parts of the subject. The writer has long felt that the most pressing need of modern meteorology is that someone should set down on paper the things we definitely know, and are all agreed upon. Failing that, a clear statement of the things we do not understand should be of some little value. It is of course possible that the difficulties discussed above are not difficult to some readers of the *Meteorological Magazine*. Should this prove to be the case, perhaps they will be good enough to expound their views.

OFFICIAL PUBLICATIONS

The following publications have recently been issued:—

The Weather Map. An Introduction to Modern Meteorlogy. By Sir Napier Shaw, F.R.S. (M.O. 225*i*), Sixth issue.

The first edition of the *Weather Map* was published in 1916 for the benefit primarily of those who were making use of meteorology in the late war.

The book opens with a detailed account of the method of

constructing weather maps, illustrated by charts showing the distribution of the weather, winds, temperature and pressure on the same day, August 2nd, 1915. The sequence of weather and its classification according to a few simple types of pressure distribution are next dealt with, two examples being given of the effect of notable cyclonic depressions which have passed over the British Isles, illustrated by a series of maps. The upper air and the conditions prevailing there are then described. As a supplement, climatic summaries are given for London, Paris, Balkan Peninsula, Mesopotamia, Egypt and East Africa, as representing the types of climate in the various theatres of war, together with a series of isopleth diagrams of the mean temperature, pressure, wind, rainfall and humidity at the four observatories of the Meteorological Office. The climate of the British Isles is further illustrated by charts showing the normal distribution in January and July of day and night temperatures, bright sunshine and rainfall.

PROFESSIONAL NOTES—

No. 42. *The Investigation of the Winds in the Upper Air from Information regarding the place of Fall of Pilot Balloons and the Distribution of Pressure.* By J. Durward, M.A. (M.O. 273*b*).

This note discusses the horizontal movements of pilot balloons in relation to the distribution of pressure. The data used are obtained from post cards, on which the date, place and time of origin are entered, attached to the pilot balloons. These balloons are released three or four times a day at many stations and the finder is requested to return the card after entering the place and time of finding. During 1923 over 1,000 cards were returned.

The results of this investigation throw a certain amount of light on the direction of winds at high levels, especially in a few instances in which the balloons travelled at high speeds for great distances, but the method is attended by so many uncertainties that it is on the whole inferior to the careful observation of high clouds. On the other hand it is practicable in all weathers.

Discussions at the Meteorological Office

November 9th, 1925. *The light of the night sky, its intensity variations when analysed by colour filters.* By Lord Rayleigh (London, Proc.R.Soc., A. 106, 1924, pp. 117-137, and A. 109, 1925, pp. 428-444). *Opener*—Dr. G. M. B. Dobson.

In recent years Lord Rayleigh has made a special study of the light received from the night sky. The essential feature of this light is its comparative redness, there being about ten times as much red colour relatively to the blue as in the twilight sky.

It is therefore not atmospherically diffused sunlight; possible explanations are that it is sunlight scattered by cosmical dust, and that it is due to light from stars individually indistinguishable. The light is too feeble for ordinary spectrographic work, but after using a preliminary apparatus Rayleigh was able to construct a spectrograph working at F/1·8 and later one of F/0·9. The main feature of the spectrum is the green auroral line which can be photographed on most nights, though its intensity is variable. Rayleigh proposes to call this permanent aurora, the non-polar aurora. A faint continuous spectrum showing dark lines is present, and two new bright lines in the violet (4200 Å and 4430 Å) were found. It was at first thought that the intensity of the non-polar aurora increased with distance from the pole, but this is probably not the case. Rayleigh favours the theory that the light is of phosphorescent origin in the upper atmosphere. The light is not polarised, and there is no simple relation to magnetic character or the number of sunspots.

Dr. Simpson stated that in Norway it was possible to detect the green line when a black cloth, situated at a little distance from the observer, was viewed spectroscopically. Messrs. Knox-Shaw and Bonacina mentioned the obvious variations in the visual intensity of the general light of the night sky. Other interesting points were brought out in the discussion, including the possible sources of error in the investigations.

November 23rd, 1925. *The Kalahari Project.* By E. H. L. Schwarz (Matériaux pour l'étude des calamités, 1. (1925), pp. 291-332). *Opener*—Mr. C. W. Lamb, B.Sc. (see page 262).

The subject for discussion for the next meeting, on Monday, January 18th, will be two papers by W. Wiese :—

Polareis und atmosphärische Schwankungen (Geog. Ann. Stockholm VI, 1924, pp. 273-299), and *Die Einwirkung der mittleren Lufttemperatur im Frühling in Nord-Island auf die mittlere Lufttemperatur des nachfolgenden Winters in Europa* (Met. Zs. 42, 1925, pp. 53-57). *Opener*—Sir Gilbert Walker, C.S.I., F.R.S.

Royal Meteorological Society

On November 11th Dr. C. G. Abbot, honorary member, director of the Astrophysical Observatory, Washington, and secretary of the Smithsonian Institution, delivered a popular lecture on "Measuring the Sun's Rays." The subject matter of the lecture was dealt with in the article entitled "Weather Forecasting with the Help of the Sun," which appeared in the *Meteorological Magazine* for November, 1925, p. 237. The Smithsonian

Institution is now trying to improve the solar radiation observations. The two stations in Arizona and Chile are not sufficient, and on many days no observations are obtained. The National Geographical Society of the United States has made a grant to establish a third solar radiation station in the eastern hemisphere. The requirements are a stable government, ready means of communication, cloudless skies, and a high altitude, and Dr. Abbot is now on his way to examine possible localities in south-west Algeria, north-east Baluchistan, and south-west Africa.

The first of the regular monthly meetings of the Society during the present session was held on Wednesday, November 18th, at 49, Cromwell Road, South Kensington, Capt. C. J. P. Cave, M.A., President, in the Chair.

Sir Gilbert Walker, C.S.I., F.R.S., and E. W. Bliss, M.A.—On correlation coefficients: their calculation and use.

This paper dealt mainly with practical considerations. By employing as a unit for each variant to be correlated the standard deviation divided by $\sqrt{20}$, a considerable saving of time can be effected. Calculations were also given of the likelihood that with any given coefficient the forecasted and the actual departures will have the same sign, and also of the frequency with which it would be possible to make a forecast with a 4 : 1 chance in its favour. Finally, an example was given of the danger of working with differences from one year to another unless special precautions were taken. In the discussions some instances were given in which the use of such differences led to useful results.

C. O. Stevens—Note on the variations in transparency of the atmosphere observed by means of a projected telescopic image of the sun.

When an image of the sun is projected into a darkened room through a non-achromatic telescope, prismatic colours are seen on the screen, and these give information as to the condition of the atmosphere. A predominance of green is especially indicative of rain. In the discussion it was pointed out that the same principle was utilised in the old " rain-band " spectroscope.

N. L. Silvester, M.Sc.—Notes on the behaviour of certain plants in relation to the Weather.

An investigation was made to test the local forecast value of plants reputed in weather-lore to give predictions by movements in their flowers or leaves. The analysis of 1,300 observations upon pimpernel, daisy, chickweed, clover, dandelion, marigold and gentian gave negative results. Temperature of the soil surrounding the roots proves to be a control factor in the movements of daisy and chickweed. Above the critical temperature in these two plants and in the pimpernel, relative humidity becomes the dominant factor, a value of approximately 80 per cent. being the critical maximum. Clover leaves respond to

wind velocity. The closing movement commences when the velocity at 42 ft. above the surface exceeds 20 m.p.h. Those plants that respond to relative humidity can thus be used for prediction of rain only in so far as its incidence is preceded by the required humidity, and they are unreliable as local weather forecasters. These conclusions refer only to the irregular day movements. The cause of the regular movements near sunrise and sunset has not been solved by this investigation.

Correspondence

To the Editor, *The Meteorological Magazine*

Ground Horizontal Visibility and Convection

THE investigation into the relationship between upward convection currents and ground horizontal visibility at 13 h. at Cranwell, Lincolnshire, which was described in the *Meteorological Magazine* for April, 1924, p. 63, has now been continued over a total of six summers, 1920-1925 inclusive.

As before, the criterion for the presence of convection currents upward was taken to be the presence of cumulus or cumulonimbus at or within the neighbourhood of 13 h.

The results obtained are shown in the accompanying table and justify further the conclusion previously arrived at, that convection days are more likely to be accompanied by good visibility, that is a visibility of 13 miles or more, than are non-convection days, and are very unlikely, indeed, to be accompanied by poor visibility, that is a visibility of less than 2¼ miles.

Cumulus or Cumulo-Nimbus at or about 13 h.	Total No. of Observations.	Ground Horizontal Visibility at 13 h.					
		13 miles or more		2¼ miles or more, but not reaching 13 miles.		Less than 2¼ miles	
		Total No.	Per cent.	Total No.	Per cent.	Total No.	Per cent.
Present ..	756	369	48·8	386	51·1	1	0·1
Absent ..	342	84	24·6	245	71·6	13	3·8

WILLIAM H. PICK.

R.A.F. Cadet College, Cranwell, Lincolnshire. September 30th, 1925

Winter Thunderstorms

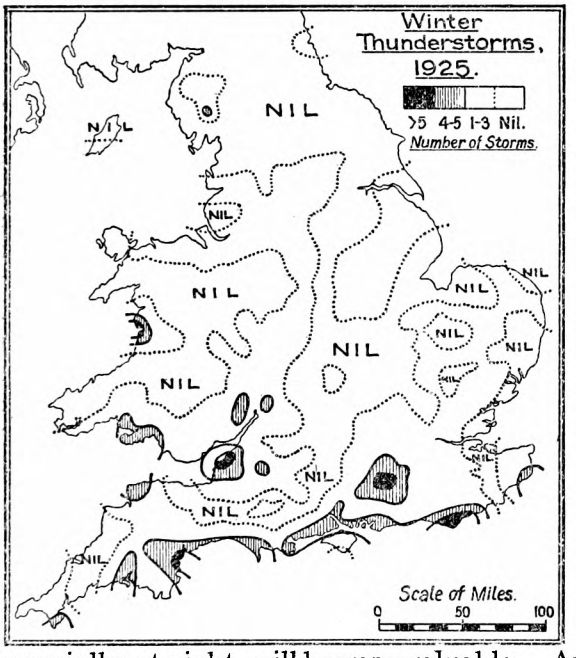
AN appeal was made in December, 1924, to readers of the *Meteorological Magazine* for reports of thunder or lightning occurring during the first three months of this year. I should like to thank very sincerely the large number of observers who supplied information.

Thunderstorms occurred somewhere in the British Isles

between January 1st and March 31st, 1925 (both dates inclusive), on 57 days. The following table shows the number of days for each country :—

1925.	England and Wales.	Scotland.	Ireland.	British Isles.
January	10	12	10	17
February	20	10	8	23
March	16	5	4	17
Total ...	46	27	22	57

The distribution of the thunderstorms in England is shown on the accompanying map. In Scotland there was scarcely more than one storm in any of the eastern or southern counties ; but on the west coasts of Ross, Inverness and Argyll, and in the Western Islands, storms were particularly frequent.



It is hoped to continue the investigation during this winter, and I shall, therefore, be very glad to receive reports of thunderstorms in any part of the British Islands, especially in Scotland or Ireland, between January 1st and March 31st, 1926, inclusive. A note on a post card of the date and time of the occurrence of thunder or lightning, with the direction in which the lightning was seen, especially at night, will be very valuable. Any additional information of the following character will be extremely welcome :—

1. The time when the storm passed overhead or was nearest, with its direction ; and how long it lasted.
2. An estimate of the severity of the storm.
3. Whether it was accompanied by rain, hail or snow.
4. Direction and strength of wind ; change of wind (if any).
5. Whether there was a change in temperature during the storm.
6. Any other observation which may be of particular moment.

It is particularly asked that the position of the place of observa-

tion should be indicated by mentioning the estimated distance and direction from the nearest town. A note that no thunder or lightning has been observed will be useful.

S. MORRIS BOWER.

Langley Terrace, Oakes, Huddersfield. November 3rd, 1925.

Crepuscular Rays

I WAS interested to read Mr. Knight's letter on Crepuscular Rays in the September issue. I saw a similar phenomenon on the evening of May 18th, 1924, at Wadhurst (Sussex). A few minutes after sunset I observed two well-defined luminous rays converging to a point on the south-east horizon. The sky was mainly clear, but with fine, detached cumulo-nimbus cloud in places. Two of these clouds were towards the south-east horizon, but the rays had no apparent relation to their forms.

On July 5th, 1911, Mr. G. A. Clarke of Aberdeen saw a system of eight bright rays converging to the south-east point at sunset (20 h. 55 m.). On this occasion the sky was cloudless, save for a low bank of cloud in the north-west, which covered the sun. The rays were seen right to the horizon.

The phenomenon is referred to in Humphrey's *Physics of the Air*, under the heading of " Crepuscular Rays," and is there stated to be of precisely the same origin as the well-known rays seen when the sun is behind a cloud (" sun drawing water "). Doubtless, however, the convergent rays in the south-east at sunset are much less frequently observed. Mr. Knight speaks only of dark rays, while Mr. Clarke shows only bright rays in his sketch. In my own observation each bright ray had its attendant dark one. Humphrey's explanation is that streaks or bands of pearly light are seen when the lower atmosphere is illuminated, and azure shadows when only the upper atmosphere is illuminated.

E. W. BARLOW.

October 7th, 1925.

NOTES AND QUERIES

Drought, Its Prevention and Cure

AN article* by Professor E. H. L. Schwarz, well-known for his proposals to increase the rainfall of South Africa by reconstituting the ancient lakes of the Kalahari region, was the subject of an interesting discussion at the Meteorological Office. There are several areas, such as the " Great Basin " of North America and the Lop Nor depression of Central Asia, in which a relatively low-

* The Kalahari project. Matériaux pour l'étude des calamités, Vol. I., No. 4, 1925. Genève, Soc. de Géographie.

lying central area is surrounded on all sides by higher ground. These basins formerly contained extensive lakes of which there are now only small remnants. Professor Schwarz considers that the large lakes of antiquity were maintained by " internal circulatory systems," in which the water evaporated from the lakes is condensed on the mountainous side-walls and runs back into the basin, the small amount of moisture which crosses the mountains on one side being made good by a corresponding inflow of moist air on the other side ; consequently there is no loss of water. As soon as the balance is destroyed by the diversion of any of the water, however, the internal circulatory system breaks down and there is rapid and extensive desiccation. The circulatory system in various stages of decay is well-shown in Africa. " We may divide Africa into three sections ; the north, where the internal circulatory system has disappeared, and most of the country is desert—the Sahara ; the central districts, where the great lakes maintain the internal circulatory system and where things are normal ; South Africa where the central lakes have recently dried up, and where a disaster of the first magnitude is threatened unless something is done." The Sahara formerly contained an inland sea—the " African Caspian "—with an area of 150,000 square miles, which was supplied by the northward flowing Joliba, but a coastal river cut through the hills and intercepted the Joliba to form the Niger, and the " African Caspian " dwindled to Lake Chad. Even the rivers which maintain this miserable remnant are now in danger of interception, promising a further catastrophe. In Central Africa the great lakes still function as sources of rain for the interior, but there is imminent danger that Lake Victoria will be drained into Tanganyika, with disaster to the whole Nile Valley. In South Africa the water supply to the Kalahari lakes has been intercepted by the Cunene and the Zambesi, the latter breaking through the Victoria Falls probably about 500 years ago.

The facts of river piracy are well known, and the geographical changes adduced are possible and even probable. It is conceivable that human ingenuity could reverse the process and divert all the rivers into the interior so that not a drop of the precious fluid ran waste into the sea ; that is a question for engineers. Perhaps this stage has already been reached on Mars, but the author does not propose anything on the Martian scale ; he proposes to divert the waters of the Okavango, Chobe and Cunene rivers, the water so obtained to be used for irrigation, and only the surplus to go towards reconstructing the lost lakes. The part of his argument which concerns meteorologists is that which deals with the automatic increase of rainfall following on this diversion. " To restore South Africa to fertility, we

require an additional 10 inches of rain, which spread over the million square miles is 23 billion cubic feet. To give this, we propose to impound the waters of the three rivers " whose total discharge is $2\frac{1}{2}$ billion cubic feet. " If all this water is annually added to the general stock of the country and retained in it by reason of its peculiar basin-shaped structure, *then in ten years, with the scheme in full working order, we shall obtain the requisite additional rainfall.*" The italics are our own. But here one is entitled to ask a simple question. If the rainfall increases by ten inches a year in ten years, what will happen after the ten years have passed? Will the rainfall continue to increase annually by one inch, until the country is drowned out, or is it proposed to cut off the supply of water and allow the " internal circulatory system " to continue to function without external aid? Or is there some peculiar virtue in the ten-year limit which we have overlooked? The whole question depends on the extent to which water evaporated from the proposed lakes will be again precipitated within the basin. There are several " basins " in different parts of the world into which rivers pour water, while there is no visible outflow, and in all of these the outgoing air must carry more water vapour than the incoming air. Hence, if more water is turned into the Kalahari, we should expect the outgoing air to contain more water vapour. Part of the water evaporated from the reconstituted lakes would no doubt be again condensed within the basin, but only part, and although some water might fall as rain twice over, it does not seem probable that the increased rainfall would exceed the evaporation from the lake. The author proposes to form a lake with an area of 20,000 square miles, the annual evaporation being estimated as 90 inches a year and the total area of the basin being about a million square miles. If all the evaporated water were condensed once within the basin, the average annual rainfall would be increased by about two inches, but until the experiment has actually been tried no one can say definitely what would happen.

During the past fifty years, meteorologists have realised that their science cannot be treated on a parochial or even on a continental basis; the world is one complex whole, and the climatic variations of its different parts are inter-related according to some plan which we are only now dimly beginning to guess. South Africa is drying up, but if the process of desiccation is really due to decreased rainfall, which is not yet proved, the first step is to determine whether the decrease cannot be correlated with general changes in the meteorological situation. The author quotes figures which point to an average decrease of about one inch per annum in the rainfall between the periods 1881 to 1900 and 1901 to 1920. But when we turn to north-west

Africa we find at Bathurst a decrease of nine inches per annum during the same period, and at Sierra Leone a decrease of 25 inches per annum, and both these places are on the seaward side of the rim. Even in the Cape Verde islands, in the open ocean, the rainfall has suffered a marked decrease. These facts suggest that the disappearance of the Kalahari lakes is part of some more general change, on so vast a scale that human endeavour can perhaps palliate but cannot hope to reverse it.

Tapered Rain Measures

UNDER the heading "A New Rain Measure," a description was given in the issue of the *Meteorological Magazine* for September, 1924, of a new type of rain measure which had been adopted by the Meteorological Office. For a time, difficulty was experienced in obtaining supplies of these measures, and on this account there were, in some cases, unfortunate delays in supplying observers who wished to get the new pattern measures. Manufacturing difficulties have, however, been overcome, and supplies are now available at the Meteorological Office for issue to rainfall observers.

For the 5-inch measure graduated in inches and the 8-inch measure graduated in millimetres, it has been possible to effect an appreciable reduction in the price. The former size measure can now be supplied to observers for the Office at a price of 3s. 9d., and the latter at a price of 4s. 7½d. if collected at the Meteorological Office, South Kensington. Additional charges are involved for the packing box and postage if the measures are despatched by post.

Errors in Sunshine Spheres
Preliminary Note

ACCORDING to the specification adopted by the Meteorological Office the focal length of the glass spheres used in the standard pattern Campbell-Stokes sunshine recorder must be 2·95 inches. Some investigations have recently been made for the purpose of determining to what extent the record is affected by errors in this focal length and also by the presence of striations in the glass which may affect the definition of the image formed by the sphere.

The results obtained indicate that if the focal length is too great by a few hundredths of an inch the burning power of the lens is not affected. On the other hand, if the focal length is too short so that the focus comes between the card and the sphere, the record of sunshine may be very seriously affected. The presence of striations does not appear to produce serious effects provided that the focal length is correct.

In a future article details will be given of the results obtained, together with a description of the apparatus now in use at the Meteorological Office for the accurate measurement of focal lengths.

Atmospheric Electricity: The meteorological significance of atmospherics over the sea

It was recognised in the early days of wireless telegraphy that "atmospherics" had some connection with meteorological phenomena and might be made use of in weather prediction. Investigations were made in England during and after the war but they did not lead to any positive results which could be put to practical use.

From a note by Captain R. Bureau (of the National Meteorological Office of France) and M. Covecque, published in the *Comptes Rendus* of the Academy of Science in April last, there appears to be a better prospect of making use of "atmospherics" on board ship. The note is based on observations made on the French ship *Jacques-Cartier* and is made interesting by the fact that the observations of "atmospherics" could be related to the distribution of meteorological elements over the ocean collected simultaneously by wireless reports from other ships. The authors arrived at the conclusion that the approach of a "cold front" (of the Bjerknes Theory) is preceded by the appearance of atmospherics whose intensity increases up to the passage of the front across the ship. The atmospherics begin about 250 miles away from the front by day and 400 miles away by night, and usually after the passage of the front there is a temporary decrease in atmospherics. The atmospherics recommence again in the polar air associated with the rising barometer in the rear of a depression. Atmospherics disappear as a rule when an area of falling barometer (or a warm front) is approaching.

The phenomena mentioned are found, not only in temperate latitudes, but also in low latitudes. Atmospherics there depend in general on the perturbations of the polar front. The tropical air of the warm centres of depressions, even when they are very far south, is accompanied by no atmospherics. The authors state that atmospherics are the phenomena which show most clearly the passage of meteorological disturbances in tropical regions. Other meteorological elements such as pressure, temperature, wind and humidity, indicate the passage of such disturbances in a much less regular manner, and these elements, moreover, only indicate the disturbance at the time when it reaches the place of observation. Atmospherics, on the other hand, announce it several hours in advance.

If these conclusions of the French meteorologists are corroborated by further investigations, ships in waters less frequented

than those of the North Atlantic will have at their disposal an extremely valuable supplement to their own local observations, even when they are unable to get any meteorological observations from other ships.

Meteorological Demonstration at Chester

IN response to a request from the Chester Scientific Society, a Meteorological Demonstration was given at the Annual Conversazione held in the Chester Town Hall on October 8th, 1925.

A general exhibit was arranged, consisting of synoptic charts, showing the various types of pressure distribution, with special reference to local weather conditions, and a selection of cloud photographs and upper air temperature diagrams, together with recording instruments, were displayed. A wireless receiver was installed for the purpose of obtaining the evening synoptic reports from British and Continental stations, thus making it possible to give a practical demonstration of general forecast work. The evening Shipping Inference was also received and displayed, together with a detailed local forecast for the following day.

During the evening explanations were given concerning the application of meteorology to aerial navigation, shipping, agriculture, &c., special reference being made to recent work in connexion with upper air investigation.

Great interest was shown in the various branches of the work, and all members of the Sealand Meteorological Staff were fully occupied in answering the numerous questions. Some 600 people visited the demonstration, and it is evident, from the enthusiasm shown, that there is considerable scope for further work of a similar nature.

H. F. JACKSON.

Trees and Climatic Zones

AN article by Henry I. Baldwin in the *Bulletin of the American Meteorological Society* for July, 1925, describes the results of experiments in planting forests with seed from different regions. It is found that seed from trees in the same climatic zone gives the best results, and that there is less risk in using seed from a region colder than the planting site than vice versa. It has been found for instance that the Scotch pine grown in Sweden from German seed forms a large percentage of crooked stems, and the importation of seeds from countries to the south has been prohibited. Sweden itself has been divided into a number of zones according to the summer temperatures, and change of more than one zone is discouraged even though the natural range of the tree is not passed.

Reviews

La Meteorologia Agraria in Italia. By D. Bernardo M. Paolini, O.S.B., La Met. Prat. Montecassino, VI., No. 3, 1925, pp. 93-107.

IN this highly interesting paper the development and the present state of the relations between meteorology and agriculture in Italy are reviewed by the Director of the Observatory of the Benedictine Monastery of Montecassino, about sixty miles north-west of Naples.

The author's own practical contribution to the study of the complicated problems of agricultural meteorology is noteworthy. Beginning in 1913 with reports and studies, published in the bulletin of his observatory, on the relations between meteorological conditions and plant life, with special reference to the hill district of Montecassino and to a neighbouring locality on the plains, he was led to develop an efficient meteorological-phenological service. Towards the end of 1914, monthly reports of phenological observations on members of nine main groups of the vegetable kingdom, together with much information of a meteorological character, were being received at the Montecassino Observatory from no fewer than forty-two stations well distributed throughout Terra di Lavoro. This admirable organization, which survived the difficult years of war and continues to this day, is the immediate outcome of Dom Paolini's resolve to endeavour to apply the results of meteorological observations to the requirements of agriculture and so to stimulate interest in questions which are of fundamental importance to Italy, but which had been largely neglected for many years.

One of the earliest workers in this field in Italy was Giovanni Targioni who, in the second half of the eighteenth century, studied weather conditions in relation to agriculture in Tuscany. During the first quarter of the ensuing century Targioni's son, Ottaviano, published a number of phenological and kindred observations made in the vicinity of Florence. In subsequent years phenological or meteorological-phenological studies having more or less direct bearings on agricultural problems were carried out, somewhat intermittently, by various individuals and mainly in the northern provinces; but owing presumably to political circumstances it was not until much later in the century that any comprehensive scheme of study was attempted. In 1883, Professor Targioni Tozzetti, in conjunction with the Italian Meteorological Association, proposed the establishment in a number of suitable localities of stations where definite observations should be made of the phenomena of plant and animal life as related to meteorological conditions and other aspects of environment. Shortly after this proposal was made the Department of Agriculture, recognising the need of sustained observational work,

initiated a scheme whereby observations were to be made on a large number of species of cultivated and naturally occurring plants at thirty-eight of the observatories and stations associated with the Meteorological Office. This enterprise was extremely short-lived, for after the publication, in 1887, of the collected results of the first year's work, together with observations for several preceding years provided by Da Schio and Lampertico for sixteen stations in the Veneto and in Emilia, nothing further appears to have been done. The author thinks that the failure of the enterprise may be attributed chiefly to the excessive number of species selected for observation. On the other hand the publication, in the *Rivista Meteorico-Agraria* of the Meteorological Office, of information relating to extremes of temperature, rainfall and raindays for ten-day periods at upwards of fifty stations, together with brief reports concerning weather and crop conditions, has continued from 1879 until now.

From about the time when Paolini's efforts commenced, sundry schemes of work have been proposed from official sources. In 1912, Professor G. Azzi, of the Ministry of Agriculture, proposed the establishment in Italy of an agricultural-meteorological organization similar to the elaborate service which had been developed by Brounoff in Russia. A few years later, Azzi suggested a somewhat simplified programme, but nothing material resulted until 1921, when the Ministry of Agriculture announced the establishment of a Central Office for agricultural meteorology, associated with which were to be stations of three classes, ranging from those fully equipped with meteorological instruments to those supplying purely non-instrumental information concerning weather conditions and crops. Apparently it was intended that the new department should be independent of the Meteorological Office and that in the first instance attention should be restricted to wheat. Dom Paolini, himself a great enthusiast, admires the enthusiasm and pertinacity of Professor Azzi, but disagrees with much of the latter's policy and especially with his advocacy of an organization of the Brounoff type, which comprised elaborately equipped observatories provided with experimental fields and a numerous highly trained staff. It is urged that such a system would be impracticable in Italy, and that the creation in every Italian province of a service on the lines of that developed by the author in Terra di Lavoro would lead more readily to good results. For Paolini affirms that the best way to ensure progress is for the meteorologist to co-operate more closely with those who are directly engaged in agriculture. His most valued correspondents are the farmers themselves, who from experience and tradition have an almost intuitive, if unclassified, knowledge of the effects of the weather on crops. To put the matter briefly, meteorology must go to school to agriculture.

Favourable comment is made on the organization for the application of meteorological information to the requirements of agriculture in the U.S.A., and the author believes that a system of daily and special forecasts similar to that which exists in Great Britain would be of great value to Italian farmers, especially if Vercelli's method of forecasting for a period of days were employed. In southern Italy the annual crop losses due to weather and climatic conditions are particularly heavy. There most of the rain falls in autumn and winter; the summer is frequently a period of drought. Knowledge of the probabilities of fine or wet spells in the seed sowing season would enable the farmer to proceed in a way best calculated to ensure that the crops should offer the maximum resistance to possible summer drought. In this respect and in many others, such as the selection of varieties of crops best suited to local climatic conditions, proper cultural operations at critical periods of crop growth, and the conservation of the water supply for irrigation purposes, great assistance could be obtained from an agricultural-meteorological organization of sufficient scope, and correspondingly great gain would accrue to national economy.

"Money spent on agriculture is as the seed which is sown; the greater the outlay, the greater the return. Let the government not hesitate to spend on 'agrarian' meteorology the millions (lire) which have been expended on aeronautical meteorology. If aeronautics can make Italy powerful, agriculture can make her wealthy!" ——— H. W. L. A.

The Probable Solution of the Climatic Problem in Geology. By Wilhelm Ramsay (Washington, Ann. Rep. Smithson. Inst., 1924, pp. 237-248).

This paper discusses qualitatively the way in which extensive mountain formation causes a general cooling of the earth's surface especially by the increase in the rain and snowfall and ultimately by the formation of extensive ice sheets. The author concludes that changes in the general relief are the main cause of geological changes of climate.

Obituary

Mr. William Stephens Clark. Mr. Clark whose death occurred at Street, Somerset, on November 20th, had the distinction of being the senior among the 5,000 observers reporting rainfall observations to the Meteorological Office. He was born at Street in 1839, and educated at the Friends' Schools at Sidcot and York and at St. Thomas's Hospital. In 1866 he married Helen Priestman, eldest daughter of the Right Hon. John Bright. Fully occupied though he was through most of his long life as head of a large and constantly growing manufacturing business, to which was added active participation in district and county

duties, especially education work, temperance and social and political reforms, he sustained in full his interest in meteorological observations. These he inaugurated in 1857, and maintained continuously until his death. His observations appeared regularly in the volumes of *English Rainfall* and its successor *British Rainfall* from 1860 to 1924, a truly remarkable record. So far as is known there only remains one survivor, Mr. J. G. Wood, of that little band of pioneers who contributed their rainfall observations to the late G. J. Symons for his earliest work. Mr. Clark was a J.P. for Somerset and one of the original County Aldermen. He promoted the establishment of technical, secondary and day continuation schools in Street, and endowed a scheme of bursaries to assist children in obtaining education beyond that of the elementary schools. A photograph and short note appeared in this magazine for April, 1924, p. 49 and p. 67.

News in Brief

The Council of the Royal Meteorological Society has awarded the Symons Gold Medal for 1926 to Lt.-Col. E. Gold, D.S.O., F.R.S., assistant director of the Meteorological Office, in recognition of his services to meteorology.

We learn from *Nature* that Professor W. H. Hobbs' expedition, to Greenland to establish a meteorological observatory there on the inland ice at an altitude of 6,000 to 7,000 feet some 150 miles from the west coast, will leave the United States in July next year. A station will be maintained there for a year and the observations will be transmitted daily by wireless to the United States and Europe. It is hoped that this service will be of great value in forecasting. Besides the ordinary observations, an investigation of the upper atmosphere will be undertaken.

Mr. F. N. Ellis, of Debdale Hall, Mansfield, reports that while a heavy snowstorm was at its height at about 7h. 20m. on November 27th, there were 5 flashes of lightning all within a mile of the house. The storm lasted from 7h. to 9h. when the day became fine and clear but very cold.

Books Received

Rechentafeln zur Harmonischen Analyse. By Dr. Leo. W. Pollak, pp. 20 (Leipzig, J. A. Barth).

Deutsches Meteorologisches Jahrbuch für 1924. Edited by Prof. Dr. Grosse, pp. 68 (Bremen Vereinigte Druckereien Jlling and Lüken), 1925.

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The Weather of November, 1925

Throughout the greater part of November fair dry cold weather prevailed over the British Isles. The month opened with mild unsettled conditions, rainfall measurements of over 25 mm. occurring at several places in the south and west, *e.g.*, 47 mm. (1·86 in.) fell at Llyn Fawr (Glamorgan) on the 1st, and 48 mm. (1·88 in.) at Holne, Devon, on the 2nd. Owing to a heavy rainstorm on the 2nd the Dolgarrog reservoir in North Wales burst and the surrounding country was flooded. During these days temperature rose in several instances to 60° F. or slightly higher. After that there was an appreciable fall which began first in Scotland and northeastern England, the maximum readings at Balmoral on the 6th and 7th being as low as 38° F. On the 7th a trough of low pressure extending eastwards from a large depression over the Atlantic caused gales in the English Channel and the Irish Sea, and much rain occurred generally in England and Ireland on the 6th, 7th and 8th, 50 mm. (1·97 in.) being recorded at Snowden (Carmarthen) on the 8th. As this trough moved southeast cold northeasterly winds backing north spread over England, and snow or sleet showers which had been experienced earlier in Scotland fell in the southeastern counties on the 9th and 10th. For the next day or two the weather was anticyclonic for the most part but between the 12th and 15th the western districts came under the influence of depressions over Iceland and the Atlantic and there was much rain or drizzle with occasional strong south winds. Subsequently anticyclonic conditions prevailed over the whole kingdom and fog occurred in many places, notably in north England and Scotland, where it persisted for many days at a stretch. By the 22nd conditions began to change and northerly winds spread over the British Isles. These strengthened during the next few days and attained gale force locally on the eastern coasts on the 25th, when a depression deepened considerably over the North Sea. The cold became much more intense and snow fell in most places; "snow-lying" to a depth of 6, 7 and 10 in. being recorded at Hull, Norwich and Scarborough on the 28th. Many low temperatures occurred during the month, screen minima falling below 20° F. in a few places, and grass minima below 15° F. The lowest grass minimum reported was 9° F., which occurred at Leuchars (Fife) on the 10th, and at Renfrew on the 26th. The total sunshine for the month was considerably in excess of the normal and the rainfall was generally below normal except on the east and southeast coasts of England. Scarborough had as much as 197 per cent. of the normal, while in Scotland, Stronvar (Perth) had only 9 per cent.

Pressure was above normal over the North Atlantic, Iceland and the northwestern coasts of Europe, and below normal over

southern and central Europe, including France and the Azores and also Denmark and southeastern Sweden, the excess being as much as 6 mb. in Iceland and the deficit 4·9 mb. at Rome. This distribution favoured northeasterly winds over the British Isles. Temperature and rainfall were generally below normal over western Europe though in the extreme north of Scandinavia the rainfall was above normal. At Spitsbergen the temperature was 5° F. above normal and rainfall 18 mm. above normal. During the first days of the month severe gales occurred on the North Atlantic, force 10 (59 m.p.h.) being reported by several liners. Many ships were damaged. About the middle of the month there were heavy falls of snow in Switzerland, central France and the land of the Slovenes. Owing to the heavy precipitation the rivers Save and Drina overflowed their banks and caused some loss of life and much material damage. Later in the month many heavy snowfalls occurred over the whole of central Europe, including Denmark and France, and the weather continued intensely cold until the end. In many places the telegraphic wires were broken and train and tramcar services dislocated owing to the snow. Gales were experienced along the coasts of southern Italy and Sicily on the 28th and 29th and caused considerable damage.

Following heavy rains throughout Iraq the Basra-Baghdad train was derailed 80 miles south of Baghdad, but owing to these heavy early rains the 1926 harvest in Iraq is expected to be prosperous. Heavy rain occurred in Morocco and on the evening of the 28th a storm swept over the valley of the Wergha and the region of Fez, during which 3 men were killed and about 20 injured.

Heavy rains fell on the 29th and 30th at Miami in Florida, flooding the streets.

The rainfall of Australia was generally above normal except in New South Wales where the deficit amounted to over 5 in. along the north coast.

The special message from Brazil states that the rainfall in the northern districts was scanty being 8 mm. below normal, in the central districts the distribution was irregular but the total was 14 mm. above normal, and in the southern districts it was plentiful with 94 mm. above normal. Fewer anticyclones passed across the country than in the previous month. The crops generally were doing well. At Rio de Janeiro pressure was 1 mb. above normal and temperature almost normal.

Rainfall November, 1925—General Distribution

England and Wales ..	88	per cent. of the average 1881-1915.
Scotland	45	
Ireland	69	
British Isles	73	

Rainfall: November, 1925: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square.....	1·54	39	65	*War.*	Birminghm, Edgbaston	1·64	42	69
Sur .	Reigate, Hartswood...	3·07	78	106	*Leics*	Thornton Reservoir ..	1·81	46	80
Kent.	Tenterden, Ashenden..	3·10	79	103	,, .	Belvoir Castle.....	1·78	45	80
,, .	Folkestone, Boro. San.	4·27	108	...	*Rut .*	Ridlington.....	1·79	45	...
,, .	Broadstairs, St. Peter's	...	..	...	*Linc.*	Boston, Skirbeck	2·22	56	111
,, .	Sevenoaks, Speldhurst.	3·13	79	...	,, .	Lincoln, Sessions House	2·50	63	133
Sus .	Patching Farm.....	2·91	74	82	,, .	Skegness, Estate Office.	3·20	81	148
,, .	Brighton, Old Steyne .	3·66	93	116	,, .	Louth, Westgate	2·59	66	120
,, .	Tottingworth Park....	4·16	106	112	,, .	Brigg	2·40	61	105
Hants	Ventnor, Roy. Nat. Hos.	4·26	108	133	*Notts.*	Worksop, Hodsock....	2·02	51	103
,, .	Fordingbridge, Oaklnds	3·02	77	88	*Derby*	Mickleover, Clyde Ho..	1·89	48	85
,, .	Ovington Rectory	3·05	77	92	,, .	Buxton, Devon. Hos...	3·00	76	64
,, .	Sherborne St. John Rec.	2·10	53	74	*Ches.*	Runcorn, Weston Pt...	3·04	77	110
Berks	Wellington College...	1·85	47	72	,, ..	Nantwich, Dorfold Hall	2·24	57	...
,, .	Newbury, Greenham..	2·18	55	78	*Lancs*	Manchester, Whit. Pk.	2·81	71	106
Herts.	Benington House	1·73	44	73	,, ..	Stonyhurst College....	2·51	64	56
Bucks	High Wycombe	2·43	62	98	,, ..	Southport, Hesketh...	3·02	77	96
Oxf..	Oxford, Mag. College..	1·77	45	80	,, ..	Lancaster, Strathspey.	2·45	62	...
Nor .	Pitsford, Sedgebrook..	1·61	41	73	*Yorks*	Sedbergh, Akay	2·63	67	51
,, .	Eye, Northolm.....	1·48	38	...	,, .	Wath-upon-Dearne ...	1·62	41	79
Beds.	Woburn, Crawley Mill.	1·50	38	66	,, .	Bradford, Lister Pk...	2·37	60	81
Cam.	Cambridge, Bot. Gdns.	1·28	33	66	,, .	Wetherby, Ribston H..	1·71	43	73
Essex	Chelmsford, County Lab	...	..	...	,, .	Hull, Pearson Park ...	2·76	70	126
,, .	Lexden, Hill House...	1·53	39	...	,, .	Holme-on-Spalding ...	2·15	55	...
Suff .	Hawkedon Rectory ...	2·37	60	104	,, .	West Witton, Ivy Ho..	...	..	...
,, .	Haughley House.....	2·31	59	...	,, .	Felixkirk, Mt. St. John	2·72	69	111
Norf.	Beccles, Geldeston....	3·24	82	139	,, .	Pickering, Hungate ...	3·25	83	...
,, .	Norwich, Eaton	3·72	95	145	,, .	Scarborough.....	4·87	124	197
,, .	Blakeney	3·19	81	144	,, .	Middlesbrough	2·74	70	129
,, .	Swaffham	2·28	58	94	,, .	Baldersdale, Hury Res.	1·85	47	48
Wilts.	Devizes, Highclere....	2·24	57	84	*Durh.*	Ushaw College	2·89	73	114
,, .	Bishops Cannings	2·24	57	78	*Nor .*	Newcastle, Town Moor.	2·63	67	109
Dor .	Evershot, Melbury Ho.	3·49	89	82	,, .	Bellingham, Highgreen	1·58	40	...
,, .	Weymouth, Westham..	2·95	75	95	,, .	Lilburn Tower Gdns...	3·49	89	...
,, .	Shaftesbury, Abbey Ho.	1·91	49	59	*Cumb*	Geltsdale.....	1·64	42	...
Devon	Plymouth, The Hoe...	3·08	78	85	,, .	Carlisle, Scaleby Hall .	1·25	32	42
,, .	Polapit Tamar	4·79	122	113	,, .	Seathwaite M.....	4·70	119	35
,, .	Ashburton, Druid Ho..	5·27	134	93	*Glam.*	Cardiff, Ely P. Stn.....	2·68	68	64
,, .	Cullompton	2·96	75	86	,, .	Treherbert, Tynywaun	4·91	125	...
,, .	Sidmouth, Sidmount ..	2·48	63	79	*Carm*	Carmarthen Friary....	4·29	109	86
,, .	Filleigh, Castle Hill ...	3·85	98	...	,, .	Llanwrda, Dolaucothy.	4·69	119	79
,, .	Barnstaple, N.Dev.Ath.	3·70	94	94	*Pemb*	Haverfordwest, School	4·74	120	94
Corn.	Redruth, Trewirgie ...	4·38	111	90	*Card.*	Gogerddan.....	2·15	55	46
,, .	Penzance, Morrab Gdn.	2·87	73	63	,, .	Cardigan, County Sch. .	3·93	100	...
,, .	St. Austell, Trevarna..	6·06	154	123	*Brec .*	Crickhowell, Talymaes	2·65	67	...
Soms	Chewton Mendip	3·33	85	78	*Rad .*	Birm. W. W. Tyrmynydd	4·52	115	68
,, .	Street, Hind Hayes ...	2·11	54	...	*Mont.*	Lake Vyrnwy	3·38	86	61
Glos..	Clifton College	1·80	46	57	*Denb.*	Llangynhafal	4·08	104	...
,, .	Rendcomb College ...	...	..	...	*Mer .*	Dolgelly, Bryntirion..	4·45	113	72
Here.	Ross, Birchlea.....	1·46	37	58	*Carn.*	Llandudno	3·11	79	101
,, .	Ledbury, Underdown.	1·52	39	62	,, .	Snowdon, L. Llydaw 9	8·97	228	...
Salop	Church Stretton.....	2·38	61	81	*Ang .*	Holyhead, Salt Island.	2·74	69	66
,, .	Shifnal, Hatton Grange	1·62	41	68	,, .	Lligwy	2·35	60	...
Staff.	Tean, The Heath Ho...	2·00	51	68	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	1·41	36	62		Douglas, Boro' Cem...	2·88	73	60
,, .	Blockley, Upton Wold.	1·56	40	53	*Guernsey*				
War.	Farnborough.....	1·86	47	68		St. Peter P't, Grange Rd	...	..	...

Rainfall: November, 1925: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	2·57	65	65	*Suth.*	Loch More, Achfary...	4·89	124	57
,, .	Pt. William, Monreith .	2·47	63	...	*Caith*	Wick	1·87	48	60
Kirk.	Carsphairn, Shiel.	2·47	63	...	*Ork .*	Pomona, Deerness	2·25	57	57
,, .	Dumfries, Cargen.....	2·08	53	46	*Shet .*	Lerwick	2·42	61	57
Dum	Drumlanrig	1·81	46	43					
Roxb	Branxholme	1·56	40	47	*Cork.*	Caheragh Rectory	2·75	70	...
Selk .	Ettrick Manse.....	2·21	56	...	,, ..	Dunmanway Rectory.	3·66	93	59
Berk.	Marchmont House	2·16	55	72	,, ..	Ballinacurra	1·78	45	44
Hadd	North Berwick Res....	·92	23	41	,, ..	Glanmire, Lota Lo. ...	2·56	65	60
Midl	Edinburgh, Roy. Obs..	·81	20	37	*Kerry*	Valencia Obsy.	...	..	...
Lan .	Biggar	1·37	35	48	,, .	Gearahameen	4·50	114	...
Ayr .	Kilmarnock, Agric. C..	2·19	55	58	,, .	Killarney Asylum.....	2·88	73	51
,, .	Girvan, Pinmore.....	2·39	61	45	,, .	Darrynane Abbey	2·80	71	55
Renf.	Glasgow, Queen's Pk..	·91	23	24	*Wat .*	Waterford, Brook Lo..	2·47	63	65
,, .	Greenock, Prospect H..	1·46	37	22	*Tip .*	Nenagh, Cas. Lough...	2·65	67	66
Bute.	Rothesay, Ardencraig.	1·52	39	30	,, .	Tipperary	2·09	53	...
,, .	Dougarie Lodge	2·31	59	...	,, .	Cashel, Ballinamona ..	1·78	45	51
Arg .	Ardgour House	2·28	58	...	*Lim .*	Foynes, Coolnanes	2·48	63	62
,, .	Manse of Glenorchy..	1·56	40	...	,, .	Castleconnell Rec.	2·43	62	...
,, .	Oban	2·03	52	...	*Clare*	Inagh, Mount Callan ..	3·86	98	...
,, .	Poltalloch	1·96	50	35	,, .	Broadford, Hurdlest'n.	2·85	72	...
,, .	Inveraray Castle.....	2·17	55	26	*Wexf*	Newtownbarry	2·89	73	...
,, .	Islay, Eallabus.....	3·54	90	66	,, .	Gorey, Courtown Ho...	3·83	97	110
,, .	Mull, Benmore	...	..	...	*Kilk.*	Kilkenny Castle	1·81	46	59
Kinr.	Loch Leven Sluice	·94	24	26	*Wic .*	Rathnew, Clonmannon	4·29	109	...
Perth	Loch Dhu	1·70	43	20	*Carl .*	Hacketstown Rectory .	3·07	78	79
,, ..	Balquhidder, Stronvar.	·72	18	9	*QCo..*	Blandsfort House.....	...	..	...
,, ..	Crieff, Strathearn Hyd.	·75	19	17	,,	Mountmellick	...	..	...
,, ..	Blair Castle Gardens ..	·72	18	21	*KCo.*	Birr Castle.....	2·14	54	69
,, .	Coupar Angus School..	·88	22	32	*Dubl.*	Dublin, FitzWm. Sq...	3·37	86	126
Forf.	Dundee, E. Necropolis.	·88	22	36	,, .	Balbriggan, Ardgillan .	1·95	49	68
,, .	Pearsie House.....	1·26	32	...	*Me'th*	Drogheda, Mornington	1·77	45	...
,, .	Montrose, Sunnyside..	1·19	30	45	,, .	Kells, Headfort.....	1·99	51	59
Aber.	Braemar, Bank	2·01	51	52	*W.M*	Mullingar, Belvedere .	2·36	60	69
,, .	Logie Coldstone Sch. ..	1·43	36	47	*Long*	Castle Forbes Gdns....	3·07	78	85
,, .	Aberdeen, King's Coll..	1·90	48	64	*Gal .*	Ballynahinch Castle ..	4·33	110	72
,, .	Fyvie Castle	2·81	71	...	*Mayo*	Mallaranny.....	5·10	130	...
Mor .	Gordon Castle.....	1·82	46	63	,, .	Westport House.....	3·86	98	79
,,	Grantown-on-Spey....	1·59	40	53	,, .	Delphi Lodge	5·82	148	...
Na .	Nairn, Delnies.....	·68	17	29	*Sligo*	Markree Obsy.	3·59	91	85
Inv..	Ben Alder Lodge	1·11	28	...	*Cav'n*	Belturbet, Cloverhill..	2·07	53	67
,, .	Kingussie, The Birches	·91	23	...	*Ferm*	Enniskillen, Portora ..	1·85	47	...
,, .	Loch Quoich, Loan....	...	..	...	*Arm.*	Armagh Obsy.	1·57	40	55
,, .	Glenquoich	...	..	...	*Down*	Warrenpoint	2·46	63	...
,, .	Inverness, Culduthel R.	·79	20	...	,, .	Seaforde	3·02	77	80
,, .	Arisaig, Faire-na-Squir	1·89	48	...	,, .	Donaghadee, C. Stn...	1·51	38	50
,, .	Fort William.....	2·13	54	26	,, .	Banbridge, Milltown .	1·94	49	71
,, .	Skye, Dunvegan.....	5·76	146	...	*Antr.*	Belfast, Cavehill Rd. .	2·10	53	...
,, .	Barra, Castlebay	...	..	...	,, .	Glenarm Castle.....	2·64	67	...
R&C	Alness, Ardross Cas. ..	1·77	45	44	,, .	Ballymena, Harryville	2·69	68	66
,, .	Ullapool.....	2·87	73	...	*Lon .*	Londonderry, Creggan	3·06	78	75
,, .	Torridon, Bendamph..	4·13	105	45	*Tyr .*	Donaghmore	2·17	55	...
,, .	Achnashellach	3·21	82	...	,, .	Omagh, Edenfel	...	..	...
,, .	Stornoway	4·34	110	74	*Don .*	Malin Head	2·06	52	63
Suth.	Lairg	...	..	...	,, .	Rathmullen.....	2·98	76	...
,, .	Tongue Manse.....	3·22	82	70	,, .	Dunfanaghy	3·17	81	67
,, .	Melvich School.....	3·22	82	80	,, .	Killybegs, Rockmount.	...	..	...

Climatological Table for the British Empire, June, 1925

STATIONS	PRESSURE		TEMPERATURE						Mean	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values							Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
			Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.							
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1020·4	+ 3·7	84	44	70·5	51·4	60·9	+ 1·7	52·3	77	4·4	1	— 54	1	9·0	55
Gibraltar	1015·2	— 2·2	83	53	74·5	61·6	68·1	— 2·4	60·6	82	6·0	37	+ 25	4	...	...
Malta	1013·8	— 1·8	89	64	78·2	67·5	72·9	+ 0·2	65·3	67	1·8	1	— 1	1	9·7	67
Sierra Leone	1012·6	— 0·1	92	68	86·3	72·5	79·4	— 1·1	75·0	81	6·5	416	— 74	23	...	...
Lagos, Nigeria	1010·8	— 2·1	88	71	85·2	74·2	79·7	+ 1·1	75·4	86	9·3	518	+ 35	23	...	...
Kaduna, Nigeria	1013·4	— 0·4	93	...	85·4	...	...	...	71·2	84	2·4	295	+ 96	19	...	...
Zomba, Nyasaland	1016·3	— 1·3	87	48	76·1	53·1	64·6	+ 1·9	...	85	4·1	1	— 13	1	...	...
Salisbury, Rhodesia	1018·0	— 1·2	79	35	72·5	43·9	58·2	+ 1·8	52·3	60	1·3	0	— 1	0	9·7	87
Cape Town	1018·4	— 1·5	77	37	61·6	47·9	54·7	— 1·1	49·3	90	6·0	237	+128	17	...	...
Johannesburg	1022·3	— 1·2	68	28	59·5	39·0	49·3	— 1·4	38·7	53	1·1	2	— 1	1	9·4	90
Mauritius	1017·3	— 1·7	80	54	77·5	61·7	69·6	+ 0·2	67·6	74	3·2	53	— 18	12	7·9	72
Bloemfontein	...	...	67	22	59·1	29·6	44·3	— 3·3	35·5	83	2·8	0	— 12	0	...	...
Calcutta, Alipore Obsy.	999·7	0·0	101	75	92·2	79·2	85·7	+ 0·6	80·3	85	8·6	192	—110	15*	...	...
Bombay	1002·8	— 1·2	90	75	86·8	78·5	82·7	— 1·2	78·0	81	7·5	708	+203	20*	...	...
Madras	1003·9	+ 0·1	104	77	99·4	81·2	90·3	+ 0·2	75·8	55	5·7	6	— 42	1*	...	...
Colombo, Ceylon	1008·4	— 0·3	89	72	86·3	77·0	81·7	0·0	78·5	76	9·2	307	+111	25	4·6	37
Hong Kong	1005·4	— 0·7	91	72	85·6	77·6	81·6	+ 0·2	77·3	76	8·0	593	+184	19	6·6	49
Sandakan	...	...	92	72	88·7	75·2	81·9	+ 0·2	76·1	81	...	256	+ 71	13	...	...
Sydney	1022·3	+ 4·4	70	46	63·9	50·5	57·2	+ 2·5	52·4	80	6·0	152	+ 29	18	4·7	47
Melbourne	1024·2	+ 5·7	65	35	57·1	43·0	50·1	— 0·3	46·2	90	7·4	23	— 30	14	2·8	29
Adelaide	1024·0	+ 4·9	69	37	62·5	46·5	54·5	+ 1·1	49·5	76	5·6	59	— 19	11	5·2	54
Perth, W. Australia	1017·9	0·0	78	42	66·0	50·0	58·0	+ 1·2	52·1	75	6·8	216	+ 42	16	4·5	45
Coolgardie	1019·7	+ 0·6	76	36	66·1	44·5	55·3	+ 2·6	47·0	62	4·8	58	+ 27	7	...	...
Brisbane	1020·1	+ 1·9	76	41	69·2	51·4	60·3	0·0	54·3	74	3·9	186	+119	12	6·7	64
Hobart, Tasmania	1023·2	+ 8·9	63	32	52·5	40·8	46·7	— 0·1	41·9	83	5·7	61	+ 5	14	4·3	48
Wellington, N.Z.	1016·3	+ 2·0	62	32	52·8	42·6	47·7	— 1·8	45·2	83	7·7	212	+ 86	21	2·5	27
Suva, Fiji	1013·1	— 0·5	83	63	78·1	68·2	73·1	— 1·8	68·9	79	6·5	120	— 36	15	...	...
Apia, Samoa	1011·1	— 0·5	87	71	84·9	73·1	79·0	+ 1·2	75·6	75	4·0	75	— 56	12	8·5	75
Kingston, Jamaica	1013·9	+ 0·1	91	70	88·6	72·4	80·5	— 0·8	71·3	76	6·5	14	— 91	4	...	...
Grenada, W.I.	1014·5	+ 1·2	89	71	84·3	73·9	79·1	+ 0·3	75·0	77	7·3	204	— 15	25	...	...
Toronto	1013·7	— 0·6	95	42	77·2	56·3	66·7	+ 4 1	59 0	67	3·9	53	— 17	13	10.0	65
Winnipeg	1010·2	— 2·3	88	38	70·8	50·7	60·7	— 1·5	...	...	6·4	60	— 23	19	5·7	35
St. John, N.B.	1012·0	— 2·0	89	44	64·6	48·8	56·7	+ 0·2	52·2	77	7·0	127	+ 44	18	5·1	33
Victoria, B.C.	1016·5	— 0·4	95	45	65·5	49·9	57·7	+ 0·7	51·8	71	5·0	7	— 17	5	10·1	63

*For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

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The Climatology of the United States*

IT is now nearly seventy years since the publication of Blodget's classical *Climatology of the United States*, and in all that long interval no similar descriptive work has appeared dealing on a uniform plan with the whole of the area. There has been a vast accumulation of reliable statistics, and a large number of books and papers have dealt with local areas or special elements of the climate, but the only book which attempted a comprehensive treatment—A. J. Henry's *Climatology of the United States* (1906)—was an official publication of the United States Weather Bureau and was almost entirely statistical. A new descriptive climatology was therefore overdue, and Professor Ward has supplied the need in a very satisfactory manner.

To write a description of the climate of a large area which shall be full and accurate, and at the same time readable, is not an easy task, and would be impossible to any one who had not a close personal acquaintance with the weather of all parts of the country. Professor Ward has the knack of combining scientific accuracy with practical illustrations—as in his advice to campers in mountain regions to locate their fires on the downhill side of their camp, so that the descending flow of cold air will carry the smoke away from the camp. He also avoids long and indigestible masses of figures, the few tables he gives being of the simplest possible nature; instead he presents the

* R. DE C. WARD. *The Climates of the United States.* 8¼×5¾, pp. xvi. +518 (*illus.*), Boston, U.S.A., Ginn and Co., 1925, 4 dollars.

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statistical matter graphically in the form of curves and charts. This omission of tables is justified because any one requiring detailed figures is given full references to the numerous publications of the U.S. Weather Bureau.

The book contains 23 chapters, beginning with an historical introduction and passing from the major climatic controls to the climatic provinces of the United States, and then to the weather element in climates. The latter chapter is illustrated by typical weather charts and by reproductions of barograms and thermograms. Chapter V. deals with temperature; as the extremes range from below − 60° F. to 134° F. there is much to be said about this subject.

Chapter VI. discusses the important subject of frosts, and Chapter VII. the prevailing winds. The next three chapters are devoted to rainfall; here again the most varied conditions are met with in different parts of the country. In Chapter XI., snowfall, there is much matter of great interest in connexion with snow surveys and the economic importance of snowfall for agriculture in dry regions. The annual snowfall of 800 inches on the mountain somewhat inappropriately christened Rainier must be very near a world's record. Chapter XII. deals with humidity, evaporation and "sensible temperatures"; the material here is less complete than that for most other elements. Chapter XIII. deals with sunshine, cloudiness and fog; in connection with the latter element it is interesting to note that the U.S. Weather Bureau apparently realised the need for a definite criterion of fog as early as 1894, and adopted a visibility of 1,000 feet as the limit of dense fog. The charts of "dark days" due to the smoke from forest fires are also of great interest; one finds it hard to realise that the smoke from a forest fire can cause a "dark day" 2,000 miles away.

Chapter XIV. deals with thunderstorms, for which, owing to the practice of insurance against lightning, the statistics are very complete. The next chapter describes those "peculiarly and characteristically American" phenomena, tornadoes; then we have: cold waves, northers and blizzards; hot waves and the "Indian Summer"; hot winds and Chinook winds; land and sea breezes and mountain and valley winds. We are told that the cold waves of the eastern United States are also unique and typically American; they are simply the cold northerly winds in the rear of a depression, but their intensity is due to the peculiar conditions in North America. The Chinook is the Föhn wind of Montana, in which a rise of 31° F. has been recorded in three minutes.

In Chapter XX. the essential characteristics of the United States climates are reviewed, district by district. Chapters XXI. and XXII. deal with the practical subjects of climate and

health, and climate and crops; it is curious that no reference is made to the views of Ellsworth Huntington on the effect of climate on efficiency. The final chapter gives a brief description of the climate of Alaska.

There is a good index to the text, but this would have been more valuable if it had included also the numerous references given in the footnotes. The printing is excellent, and the illustrations are for the most part clear, although some of the line-blocks are confusing. The lithographed rainfall map which forms the frontispiece is both clear and artistic.

The Cierva Autogyro

By E. TAYLOR, M.A., B.Sc.

Señor Don Juan de la Cierva's Autogyro, marking a new departure in aerial navigation, has been brought prominently to public notice by reason of its successful trials at the Royal Aircraft Establishment, Farnborough, on October 12th, 1925. The success of the machine dates, however, from 1923, since when repeated flights have been made in Spain and in France. Tribute must be paid to the patient research of the inventor, whose ultimate triumph was won only after many flying accidents. Between 1920 and 1923 he carried out some thirty-two reconstructions, embodying five types of machine.

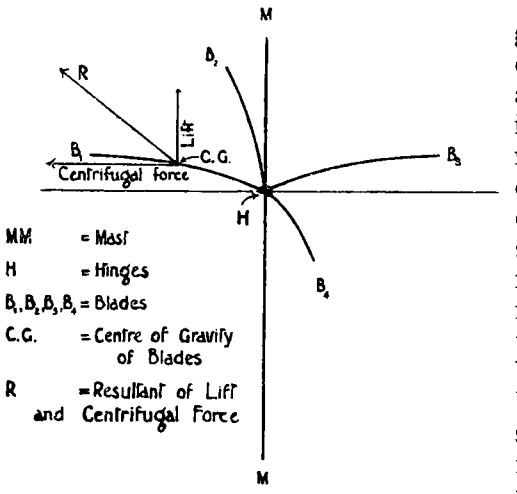
The autogyro resembles an aeroplane in having a fuselage, engine and propeller. It differs from an aeroplane in having a four-bladed wind vane instead of wings as ordinarily understood. There are certainly ailerons fitted to the fuselage, but their function is simply to provide lateral control. The wind vane is the characteristic feature of the autogyro, and is in effect a system of wings which rotate in ball bearings about a mast fixed in front of the pilot vertically with respect to the machine in normal straight flight, but capable of some adjustment about the vertical. The vane is not driven by the engine. A number of men, by pulling on a rope, provide an initial speed of revolution with the machine stationary, after which, the blades having a positive incidence to the plane of rotation, the vane rotates freely in the air stream generated by the forward motion derived from the propeller, and so supports the machine in the air.

The manhandling operation is not essential, and is undertaken simply because an initial speed of revolution reduces the length of run required. The autogyro is not a helicopter—at least, not yet—and requires a certain "take off" in the same way as an aeroplane. Its achievement consists in its low minimum speed and in its ability to land at angles considerably steeper than 45° with a landing run of the order of 50 feet.* With an

* In one test the measured landing run was 39 feet.

undercarriage suitably designed to take landing loads an almost vertical descent is practicable.

One might suppose here that the simplicity of the principle caused it to elude for so long the wit of inventors. As a matter of fact, however, the machine is not airworthy with blades rigidly fixed to the central mast, and it was not until Señor de la Cierva's unsuccessful experiments with such blades forced him to adopt the device of hinging the blades separately to the central mast, that the autogyro became practicable from the stability point of view.



This modification, by giving each blade a degree of freedom vertically, enables it to set itself according to the resultant (R) of lift and centrifugal force. Without this accommodation, since the resultant force is greater on a blade revolving into the wind than on the opposite blade, there is an unbalanced moment on one side of the machine making for instability, which evinces itself as a roll. There seems to be no reason, indeed, why such an unbalanced moment would not overturn the machine altogether.

When not rotating, the four hinged blades are supported from the mast by shock absorbers. They are also connected at points about half-way along their span by weighted wires whose function is to equalise stresses in the blades. It is noteworthy that, when the blades are not revolving, there is nothing except their weight to prevent them from folding up altogether when subjected to upward pressure. In flight they are maintained by centrifugal force in an approximately horizontal position.

Meteorological factors may be of some importance here, in that an abrupt discontinuity in wind force and direction resulting in a sudden considerable increase in lift, without an immediate change in centrifugal force, might cause abnormal lifting of the blades. It is thought, however, that no discontinuity would be sufficiently violent to involve risk on this account.

An interesting point is that the surface wind, though it matters little for taking off with the autogyro, is of importance in landing so long as the undercarriage is designed only for a forward run. For the pilot, having reduced his forward speed to make an

to face p. 280.

THE CIERVA AUTOGYRO, 1925.

approximately vertical descent, might find himself landing backwards in a moderate surface wind. During tests, the Meteorological Office, Farnborough, was frequently called upon to measure surface wind speed on the aerodrome, and to give wind data up to 2,000 feet at intervals of 500 feet. On one occasion data were given for every 200 feet.

OFFICIAL PUBLICATIONS

THE following publications have recently been issued :—

GEOPHYSICAL MEMOIRS—

No. 27. *On the design of the Kew Pattern Barometer.* By S. N. Sen, Ph.d. (M.O. 254g).

The Kew pattern mercury barometer was introduced about the middle of last century to provide a means of obtaining accurate measurements of atmospheric pressure at sea. To prevent undue " pumping " the tube must be designed in such a way that oscillations of short period are damped out while long period variations are unaffected.

The present paper deals with the principles which should govern the design of the tube and cistern of the barometer in order to secure the desired results. The problem is considered from the practical as well as from the theoretical standpoint, and the paper includes data and diagrams prepared for the purpose of assisting the maker in selecting tubes which will give the specified falling time.

PROFESSIONAL NOTES—

No. 43. *Some effects produced by protective shields on the readings of grass minimum thermometers.* By J. M. Stagg, M.A., B.Sc. (M.O. 273c.)

The results of the five series of experiments carried out at Kew Observatory may be summarised as follows. Any form of screen in the vicinity of a grass minimum thermometer will result in an increase of the temperature recorded even if the screen is only on one side of it. If any screen has to be used it is desirable that the wires should be as thin as possible.

Discussions at the Meteorological Office

December 7th, 1925. *Ozone as an absorbing material for radiations in the atmosphere.* By C. Fabry. (Pub. Mass. Inst. Tech., No. 281, 1925, pp. 20). *Opener*—Mr. C. E. Britton, B.Sc.

This paper contains the results of the author's investigation into the ultra-violet region of the solar spectrum. It is well

known that there is strong atmospheric absorption in this region beginning at about 3100 Å. The intensity of the spectrum begins to fall away rapidly at this point as we go towards the shorter wave lengths, and at 2900 Å very little radiation reaches the earth's surface. Ozone possesses a very strong absorption band in this region, and in order to ascertain whether the observed atmospheric absorption could be attributed to this gas a careful examination was made of the absorption spectra of gaseous ozone and of the atmosphere. As a result, the author concludes that the absorption of the atmosphere can be definitely attributed to ozone. He deduces that the thickness of this gas present in the atmosphere is about 3 mm. and that the amount seems independent of the meteorological conditions.

The next point discussed is the location of the ozone in the atmosphere. Chemical analysis and the investigations of Lord Rayleigh shew that the amount of the gas present in the lower layers is extraordinarily minute, being only about 5 per cent. of the quantity which would be expected if the whole of the ozone were uniformly mixed in the atmosphere. It must therefore be situated in the higher layers, where it is probably formed by the ozonizing effect of waves of very short wave length. These short wave lengths are absorbed very rapidly by oxygen and do not penetrate lower than 40 km.

The subjects for discussion for the next meetings will be :

January 18th, 1926. See p. 258. *Opener*—Sir Gilbert Walker.

February 1st, 1926. *Solar radiation and weather or forecasting weather from observations of the sun.* By H. H. Clayton (Smithsonian Misc. Coll. 77, No. 6, pp. 64). *Opener*—Capt. H. F Jackson, M.S.E.

February 15th, 1926. *Die reduzierte Laufzeitkurve und die Abhängigkeit der Herdtiefe eines Bebens von der Entfernung des Inflexion-spunktes der primären Laufzeitkurve.* By S. Mohorovičić (Beitr. z. Geophs. xiii., pp. 217-40, xiv., 1915, pp. 187-198) ; and *Über die Konstitution des Erdinnern, erschlossen ans Erdbebenbeobachtungen.* By B. Gutenberg (Phys. Zs. xiv., 1913, pp. 1217-8). *Opener*—Dr. H. Jeffreys, F.R.S.

Royal Meteorological Society

THE monthly meeting of this Society was held on Wednesday, December 16th, at 49, Cromwell Road, South Kensington. Mr. C. J. P. Cave, M.A., J.P., President, in the Chair.

I. D. Margary, M.A.—The Mursham Phenological Record in Norfolk, 1736-1925, and some others.

The paper analysed a remarkable phenological record kept by

five generations of one family at Hevingham, near Norwich, over a period of 190 years with one break of 25 years after 1810. The observations include the dates of leafing of 13 common trees, flowering of snowdrop, hawthorn, etc., and the movements of 8 migrant and other birds. The mean date for a group of seven of the plant events covering the period January to May was worked out for each year, and it was found that the annual variations of this date are closely related to the temperature variations, and there is also a periodicity of twelve years in the lateness or earliness of the springs; the next late spring is due within a few years. A similar but less marked periodicity is shown by the mean temperature at Greenwich for January to May. There is also an indication that in recent years (1891 to 1925) spring has come earlier than in the eighteenth century (1751-85). Migrant birds seem independent of these conditions; the cuckoo has maintained a fairly regular date of arrival, with some variation according to the temperature, but the swallow tends to arrive later than formerly, the average date for the period 1891-1925 being eight days later than for 1751-85.

C. D. Stewart, B.Sc.—Experiments on the shielding of Rain gauges. The chief difficulty met with in the measurement of rainfall is the effect of wind in decreasing the catch of a gauge owing to the eddies set up by its projecting parts. This paper gives an account of experiments which have been in progress for some years at Valencia Observatory to test the efficacy of different methods of shielding a rain gauge from such eddies. It has been found that protection is afforded in varying degrees by buildings, the Nipher Shield, and pits. Analysis of the traces of self-recording rain gauges has been carried out to obtain quantitative estimates of the value of the different types of protection.

H. Jeffreys, F.R.S.—On the dynamics of Geostrophic Winds. It is shown that all problems of the motions of the atmosphere produced by temperature changes of large horizontal extent can be reduced to closely related problems of tides in an ocean of uniform depth. These problems, in the absence of friction, can in general be solved by known methods. The theory is applied to the annual variation of pressure in Central Asia, and gives fair quantitative agreement. When applied to the general circulation, however, it is found to give easterly winds everywhere, contrary to observation. It appears that friction would considerably alter this result, and on examination it is found that a steady circulation is impossible when friction is present. The only dynamically admissible types of motion with friction involve westerly circulations around the poles and systems of cyclones whose height is comparable with that of the tropopause.

Correspondence

To the Editor, *The Meteorological Magazine*

The Mildness of Winters on the North Wales Coast

I feel that the following temperatures taken in the Stevenson screen in my garden here may be of interest to readers as it possibly is not realised how mild this coast usually is in winter. The screen is on low level ground at about 25 feet above the sea and half a mile from it. It would be interesting to know whether many places on the south coast of England could show higher winter minima during the six winters for which I give particulars.

Winter.	Number of Readings.		
	32°F. or below	29°F. or below	Below 25°F
1919-1920	11	4	—
1920-1921	16	5	3
1921-1922	24	12	—
1922-1923	4	1	—
1923-1924	22	5	—
1924-1925	5	3	—

Since writing the above we have participated in the usually prolonged frost of this month, having had eleven readings 32°F. or below, but with a mean minimum of not lower than 29·6° F. and an absolute minimum of 25·4° F. on the 21st.

S. Wilson.

Trem-y-coed, Sea Road, Abergele. November 24th, 1925.

Crepuscular Rays

With reference to the notes on Crepuscular Rays which have appeared in the September and December *Meteorological Magazine*, the following record was observed by my brother Herbert Priestley on the evening of September 9th.

The appearance of the sky as seen from Gourock (Renfrewshire) was very impressive. Rain had been falling during most of the day, but towards evening the sky cleared and there were some very unique effects.

Just as the sun was setting a dark belt of low cumulus cloud lay along the western horizon. It stretched well overhead. Intervening clouds were brilliantly illuminated against the dark background. On the eastern horizon a very curious effect was observed. Rays of light seemed to emanate from a point exactly opposite the sun. Each ray was not unlike a search-

light. They stretched upwards to about 45°. Those to the south were clearer than those to the north. A belt of cumulus was illuminated by the sun's rays, but the eastern rays referred to above were visible against the cloud, causing it to be light and dark alternately.

From the point of observation, Gourock Pier (L.M.&S. Rly.), the lower part of the eastern horizon was dark and probably hazy owing to the smoke of Glasgow and other industrial centres in that direction.

CHARLES F. PRIESTLEY.

49, *Brisbane Street, Greenock. October 30th*, 1925.

A Remarkably Quick Change of Visibility at Cranwell, Lincolnshire

During the morning of October 8th, 1925, there occurred here at Cranwell, Lincolnshire, a remarkably quick change in the horizontal visibility which seems worthy of notice. The visibility at 7h. was $6\frac{1}{4}$ miles, but it fell away to barely $2\frac{1}{4}$ miles and so persisted up to 10h. 20m. Within ten minutes, however, it rose abruptly to 13 miles, and persisted at 13 miles or more, up to 18h., the change being so sudden as to evoke general comment.

The explanation of the abrupt and big rise in the visibility seems to be found in the setting up of intense upward convection currents. That these currents were in existence is shown by three independent lines of evidence as follows: (A) At 10h. the sky was three-quarters clouded, the only cloud types present being alto-cumulus and alto-stratus, but nearer to 11h. there was a fine display of castellated cumulus (base 2,000 ft. high) half covering the sky; (B) a " tail method pilot balloon ascent " made at 11h. revealed the presence by direct measurement of upward currents of great velocity; and (C) R.A.F. pilots flying machines over the aerodrome at Cranwell thought the " bumpiness " (a sure sign of upward currents) so remarkable as to merit special report.

It would be a matter of great interest to know whether any similar abrupt and big increases in visibility have been noticed by other observers, and, if so, whether they were accompanied by similar heavy convection currents upward.

W. H. PICK.

R.A.F. Cadet College, Cranwell, Lincolnshire.

Thunderstorm at The Hague, December 10th

After a long period of severe frost and snow when the thermometer fell to 15 degrees and below in the screen, and snow covered

the ground for more than two weeks, a slow but decided thaw set in here early this week as the large depression centred to the south of Iceland moved slowly southeastwards, gradually replacing for the time being the Central European anticyclone. During yesterday (December 10th) the westerly wind became squally with showers of rain in the early morning. The day was fair with some sunny intervals, but the evening became stormy with driving rain and increasing wind. The thermometer rose gradually all day until at 8 p.m. it stood at 43 degrees. By that time the centre of the depression was situated near the entrance to the Skagerrak, and small secondaries were passing across England and Holland.

At about 7.50 p.m. rain descended with torrential force and the wind increased to gale strngth. At almost exactly 8 p.m., I was startled by a violent clap of thunder. After this at regular intervals of about 3 minutes, very vivid flashes of lightning occurred with simultaneous claps of thunder and the rain descended with great force. The wind shifted from W to WNW at about 8.15 p.m. and the rain eased considerably. By 8.30 p.m. the storm was over, the wind abated to a light breeze and the sky became clear. The air felt distinctly warmer after the storm than before it, in spite of the veer of wind.

This thunderstorm was very local, no thunderstorm occurring in Rotterdam, which is under 20 miles from the Hague.

J. E. COWPER.

Schiekade, 12, The Hague. December 11th, 1925.

NOTES AND QUERIES

Measurement of Planetary Radiation

A paper by W. W. Coblentz and C. O. Lampland bearing this title published as *Bulletin* No. 85 of the Lowell Observatory, gives an account of some preliminary researches into the composition of the radiation received from the moon and the planets. This consists of two parts, solar radiation reflected directly to space, and "planetary" radiation sent out by the surface and atmosphere of the planet itself. The radiation from the different planets was measured first as received and then after passing through a water cell 1cm. in thickness, which absorbs all radiation of more than 1·5μ. Since this is above the wave-length of almost all the reflected solar radiation but below that of the planetary radiation, the difference gives a rough measure of the latter. The percentage absorbed was found to be: Moon 80, Mars 30, Saturn 15, Venus 9, Jupiter 3; that is, the greater part of the radiation received from the moon is due to the heating of its surface by the sun, but practically all that received from

Jupiter is reflected solar radiation. This latter conclusion is rather surprising since the albedo of Jupiter is only 0·56, so that nearly half the solar radiation is absorbed and must be again emitted as planetary radiation. In addition it is generally believed that Jupiter is still radiating its own heat.

The reason for the discrepancy is that the long-wave planetary radiation is largely absorbed by the terrestrial atmosphere before it reaches the radiometer, whereas the reflected solar radiation is little affected. The greatest loss is suffered by the radiation emitted by the planetary atmospheres rich in water-vapour; radiation from the actual planetary surface is less liable to absorption. If the atmosphere resembles that of the earth, the percentage of the planetary radiation reaching the radiometer will be small. Hence the investigation gives valuable information as to the nature of the atmospheres in the different planets. Jupiter and Venus evidently resemble the earth closely in the presence of much water-vapour in their atmospheres. The very low value for Jupiter points also to a low temperature of the radiating surface, which causes much of the planetary radiation to lie outside the limits recorded by the radiometer. The Martian atmosphere is much less absorptive, while the moon has little or no air, so that the two latter send us radiation direct from their surfaces.

A later article by Dr. W. W. Coblentz (*Nature*, September 26th, 1925, p. 472) deals with radiometric determinations of the temperature on Mars in 1924. In studying the seasonal changes it was found that the temperature of the south polar regions rose from −60° C. in July to 10° C. or even higher at the Martian summer solstice (on October 5th), while the temperature of the north polar regions remained near −70° C., as was to be expected with winter on this hemisphere. The observed high surface temperatures on Mars may be accounted for on the assumption that these dark areas contain vegetation having the properties of the tussock mosses and lichens of our dry tundra, which have a high absorptivity for solar radiation and a low thermal conductivity. This assumption is in agreement with the visual observations and with the lower intensity of insolation on Mars. The observations also indicate that at noon in summer temperatures of 40° to 60° F. prevail.

Note on the Accuracy of the Pressure Record given by Dines Type of Baro-Thermograph

It is well known that the measurement of pressure by means of an aneroid box is subject to uncertainty on account of a hysteresis effect in the material of which the box is made. This causes it to respond to pressure changes in a sluggish manner, and in con-

sequence the instrument shows different readings as between a falling and a rising pressure, especially so when the range of pressure variation is large. This defect, commonly known as lag, is troublesome with instruments used for upper air observations, in which pressures as low as 40 mb. absolute are sometimes required to be accurately measured.

The results of some recent experiments with the Dines type of baro-thermograph, as at present used by the Upper Air section of Kew Observatory, are given below. Two definite sets of tests were made, one to determine the total lag, or difference in the pressure readings of the instrument as between a falling and rising pressure, the other to determine the difference in the pressure readings as between a rapid fall of pressure, and a slow one such as occurs in the case of an actual balloon ascent. In all cases the pressure was reduced steadily from one atmosphere to a minimum of 70 mb. In the first set of tests the total lag was found to be practically the same whether the reduction and subsequent rise of pressure was effected in 13 minutes or 1½ hours, and the values are set out in the following table :—

Pressure at which readings were taken.	Atmosphere.	780 mb.	470 mb.	170 mb.
Total lag.	About 1·5 mb.	2·7 mb.	3·1 mb.	3·2 mb.

In the second set, slow and fast reductions of pressure were made taking respectively 1 hour and 8 minutes ; they showed that under the slow reduction the aneroid box expanded on the whole a little more than under the fast one. The difference was trifling at pressures above 300 mb., below that it was such as to cause a difference of the order of 1 or 1½ mb. as shown on the pressure scale.

The conclusions reached are satisfactory and indicate the precision obtainable with instruments of the type under consideration when care has been taken to ensure correct adjustment of the recording mechanism ; the lag is greatly increased if the scribing point be allowed to bear too heavily on the plate, or if the point itself be too sharp. It follows that the calibration of these instruments may safely be performed at a comparatively fast rate (thereby saving a great deal of time), without running the risk of setting up a false standard of comparison with the actual ascent, and also that the lag due to the friction of the scribing point and the hysteresis of the aneroid box can with due care be made very small, and if desired can largely be allowed for.

The aneroid boxes fitted in the instruments under test are of the ordinary type, partially evacuated of air as is usual in the Dines baro-thermograph ; they are, however, spun up from German silver sheet which has been specially prepared before-

hand. The essential feature would seem to be that the material must be uniform in texture and in a moderately hard state before the corrugations are formed in the discs. The two halves of the box are fastened together in the usual manner, but using a minimum quantity of soft solder; otherwise no special precautions are taken in manufacture.

Pilot Balloon Ascents in Colombo

With reference to the editorial note on this subject published in the *Meteorological Magazine* for August, 1925, p. 164, Mr. Jameson writes that it was found more convenient to estimate the apparent lengths of balloon tails with a grid of wires (spider webs) placed in the field of the telescope rather than to measure them with the micrometer of the theodolite. The wires were spaced at intervals corresponding to a complete revolution of the micrometer head, or ·00169 of a radian. This interval is reckoned as 10, and the apparent length of a 20 metre tail is estimated, generally, to units and half units. When the balloon is a great distance away, estimates are necessarily crude, but the observations are sufficient to guard against gross errors caused by the adoption of a mean rate of rise in the case of a descending or non-ascending balloon. An error of 10 per cent. or even 20 per cent. in this mean rise is less than the uncertainty of the theoretical rise at high altitudes, and even with apparent tail lengths as low as 5 units an error of 20 per cent. in the deduced mean rise is unlikely.

Mr. Jameson thinks that the interrupted rise shown on the curve for May 22nd is real, and adduces a flight on September 8th which indicates a halt for about 13 minutes at a level of 250 to 300 metres followed by a steady rise to above 2 km. This day was remarkable for the absence of fracto-cumulus. These clouds are presumably due to turbulence in the lowest layers of the monsoon currents and they generally move at a minimum height of about 500 metres. At the time of flight the air would have been saturated at 600-700 metres, and the obvious suggestion is that the downward currents indicated at about 0·3 km. of the order of 1·5 m/s., opposing the upward travel of the air particles due to turbulence, were sufficient to reduce the total upward movement below the limit necessary for condensation, and hence were responsible for the disappearance of the fracto-cumulus.

Expansion of a Pilot Balloon

As a possible means of improving Pilot Balloon Ascents, it was suggested by Mr. A. E. Mayers that a suitable valve be fitted into the nozzle of the Pilot Balloon in order to allow gas to escape when the balloon had attained a predetermined height. This

suggestion rests on the assumption that the excess of the pressure of the enclosed gas over that of the surrounding air continually increases and that, finally, the rupture of the fabric occurs when this excess reaches a certain limit. Hence if by any suitable means the excess pressure could be relieved, the life of the balloon would be prolonged, and longer, if not higher, ascents could be obtained.

In order to ascertain whether such a valve could function in the manner anticipated, a number of balloons were filled considerably beyond the normal free lift. If the excess pressure increased in manner suggested, a premature burst should occur. The normal free lift given to pilot balloons of about 35 gms. in weight is in the neighbourhood of 70 gms., so that in ascent No. 4 the free lift was about three times the normal. The following are brief details of these ascents :—

Ascent.	Weight of Balloon.	Free Lift.	Time Balloon was Seen.	Height when Lost.
No. 1	21 gms.	120 gms.	55 mins.	30,000 feet
No. 2	35 ,,	125 ,,	42 ,,	23,000 ,,
No. 3	34 ,,	160 ,,	62 ,,	30,500 ,,
No. 4	33 ,,	200 ,,	19 ,,	11,600 ,,

It is interesting to note that none of these balloons was observed to burst. It would thus appear that there is little or no increase of excess pressure as the pilot balloon rises and that a release valve working on the lines suggested would be inoperative.

C. B.

Comparison of Anemometer Exposures at Holyhead

Comparisons have been made recently at Holyhead between the readings of a Dines Pressure Tube Anemograph and those of an anemobiagraph which is situated at a distance of 130 yards to the south of the first instrument, the heads being at the same height.

A preliminary comparison, extending over two separate periods of a month, indicated that there was very close agreement between the instruments for wind speeds above 15 miles per hour but that with light winds the differences were considerable. A further point brought out by the comparison was that the ratio of the velocity recorded by the pressure tube anemometer to that recorded by the anemobiagraph was less for winds from a northerly direction than for southerly winds.

A second comparison extending over three selected months was initiated by Mr. H. L. Pace of the Meteorological Office, Holyhead, who sought to arrive at a relation between the ratio of the wind speeds as recorded by the two anemometers and the

" gustiness " of the wind as deduced from the readings of the pressure tube anemometer. The gustiness factor was taken as (highest gust—lowest lull)/mean hourly wind. The results confirmed those previously obtained and also indicated a considerable variation in the amount of " gustiness " with different wind directions, a result which may be partly explained from a consideration of the exposures of the instruments.

In the diagram the full line shows the position of the low water mark at ordinary tides round Salt Island. The island slopes steeply to the sea except on the south-west side. The extreme

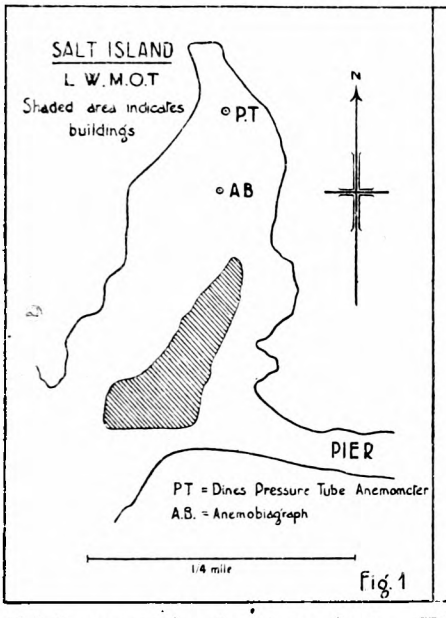


Fig. 1

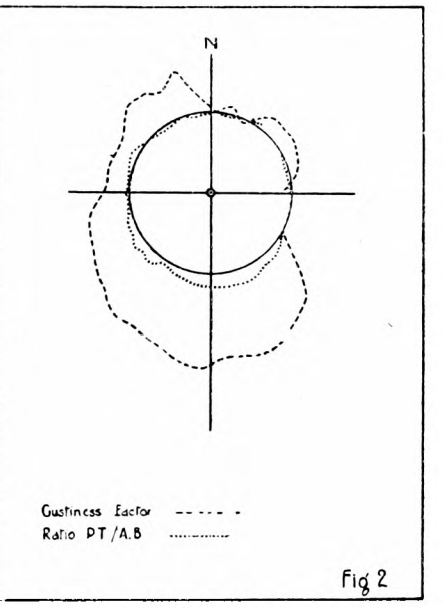


Fig 2

tidal range is about 20 feet. The shaded area on the southern side indicates the position of buildings. The variation in " gustiness " is indicated by the larger of the closed dotted curves, the circle corresponding to a " gustiness " factor of 0·5. The factor varies from 1·04 for southerly winds to 0·41 for easterly winds. The difference in gustiness between winds from northerly and southerly directions is conspicuous. The smaller of the dotted curves indicates the variation of the ratio of the wind speed as recorded by the pressure tube anemograph to that recorded by the anemobiagraph, the circle in this case indicating a ratio of 1·00. The ratio varies from 1·11 for SSE winds to 0·96 for NE winds.

The reduction in the speed of winds from a southerly direction and the increase in gustiness from this direction are probably attributable to the proximity of the buildings to the south of the anemobiagraph. In the case of winds blowing off sea a complication is introduced by the fact that the ground slopes

down steeply from the site of the pressure tube anemometer to the sea. The slope may have the effect of reducing the speed of winds blowing off the sea.

It should be mentioned that both anemometers have been calibrated and found to be in good agreement.

The Rainfall of 1925

The rainfall of 1925 over the British Isles generally was rather more than the average. A comparison is given below of the general rainfall of 1925 with that of each year since the dry year 1921.

RAINFALL—GENERAL DISTRIBUTION.

	1921	1922	1923	1924	1925	
England and Wales	70	105	113	120	—	Per cent. of the average 1881-1915.
Scotland	99	94	120	105	—	
Ireland	88	92	110	122	—	
British Isles ..	82	100	114	117	—	

Although the rainfall of 1925 for the British Isles as a whole approximated to the normal yet it contained many interesting features.

In all three countries the areas with rainfall above the average were about as large as those with deficient rainfall. England and Wales experienced less than the average over a wide coastal strip stretching from Canterbury to Hull (including the Fen District), in the Lake District and part of Pembrokeshire. The total fall was only 87 per cent. of the average at Lincoln, 96 per cent. at Seathwaite in Cumberland, and 91 per cent. at Fishguard. More than 120 per cent. of the average occurred on Dartmoor, in parts of Sussex and Hampshire, in the neighbourhood of Bath in Somersetshire, and Kirkby Stephen, in Westmorland. Along the south coast from Newhaven to the Isle of Wight more than 130 per cent. of the average occurred. At Camden Square (London) the fall of 24·91 in. was only ·44 in. or 2 per cent. above the average.

Over Scotland the fall varied from about 85 to 115 per cent. of the average. The values for Aberdeen, Fort William and Glasgow were 89, 90 and 100 respectively. More than the average occurred in three main areas, over the southern Uplands, from the Grampians to the Moray Firth, and in Sutherlandshire.

The range in Ireland was still smaller, the percentage values being generally between 90 and 110. More than the average occurred over the mountains of Wicklow, in the south-west from Valencia to Cahir, from Connemara to Sligo and Roscommon, and also along a north-eastern coastal strip from Londonderry to Belfast.

For the British Isles as a whole the wettest months in 1925 were February and May, but the rainfall of these months was exceeded in the wet years 1923 and 1924 respectively. In Ireland, however, May with 194 per cent. of the average was the wettest May since before 1881. June with only 18 per cent. of the average was the driest month of the year and the driest June since before 1881. The month was rainless in many parts of south England. March with 54 per cent. of the March average and November with 73 per cent. of the November average were also noteworthy. November was especially dry in Scotland being one of the driest Novembers in the series.

The dryness of November in the Fen District and the Thames Valley followed by a normal December total make the floods of the beginning of January 1926 appear all the more remarkable. When the incidence of rainfall is examined it is apparent, however, that the rainfall of December was concentrated into the latter half of the month. In the Thames Valley rain fell on every day from the 19th to 31st amounting to no less than 87 per cent. of the total fall of December, 1925.

Heavy Rainfall

With reference to Mr. Whipple's article "On Rainfall of very rare Intensity,"* it is interesting to note the figures quoted by Dr. J. Boerema, in his paper on the "Extension of Rainshowers at Batavia."† Ten stations in and near Batavia were equipped with recording rain gauges of the Hellmann pattern in the early part of 1923 for the purpose of studying the occurrence of heavy falls of rain in periods up to a few hours. Among other results it was found that the highest rainfall at these ten stations during the period March 1st, 1923, to January 1st, 1925, was :—

	Minutes.		Hours.						
Duration	10	30	1	2	3	4	5	10	12
Rainfall in mm.	25	59	74	89	114	137	158	188	189

Some other records of heavy rain are given in the Report for the Colombo Observatory for 1924. More than 10 in. in 24 hours were measured at several stations on the western or windward slopes of the central mountain range during the rainy season of 1924. A special article is devoted to the heavy rains of September 29th to 30th, when 12 in. occurred on the Maliboda estate and 11·96 in. on the Carney estate. This rainfall was orographical and the distribution was so theoretically correct that the rainfall map would serve as a text book example of that type of precipitation.

The Importance of Field Work in the Study of Climates‡

In a paper bearing the above title, Professor R. de C. Ward, the well-known lecturer in climatology at Harvard, points out how

* See *Meteorological Magazine*, 59 (1924), 149.
† K. Mag. Meteor Obs., Batavia, Verh. 15, 1925.
‡ Proc. Amer. Phil. Soc., 64 (1925), pp. 64-77.

the study of climates may be made interesting. Tables of statistics are, of course, a necessary basis, but they are merely the dry bones, and need to be amplified by vivid descriptions of the " living aspects," such as can only be written by those who have dwelt or travelled in the different regions. Anyone who visits out-of-the-way spots, or even passes through in a train, can help by recording his impressions, especially of the influence of climate on human activities. The teacher of climatology should himself do " field work " by visiting personally as many different types of climate as possible, in order to be able to convey his impressions at first hand. A large collection of lantern slides or cinema films is also essential, in order that the audience in turn may be conducted on an armchair tour through the country under discussion.

New Price List of Barometers Issued by C. F. Casella & Co., Ltd.

In this catalogue a very comprehensive selection of barometers, both mercurial and aneroid, is described and illustrated. The instruments available range from standard precision barometers of a type suitable for Observatories or Standardising Institutions to inexpensive aneroids of the simplest type. Four patterns of barographs of the Meteorological Office " medium " size are also illustrated.

In previous catalogues published by the same firm some interesting information with regard to the internal construction of the various types of barometers was given. The omission of this from the new catalogue, while conducing to greater compactness, is, to some extent, regrettable. Nevertheless, the intending purchaser of a barometer will find much to interest him.

Reviews

Het Klimaat van Nederlandsch-Indie. By C. Braak, K. Magn. Meteor. Obs. Batavia, Verh. No. 8, Vol. 1, Part 8. Size $11 \times 7\frac{1}{2}$, pp. 30 (Dutch) + 24 (English). *Illus.* Batavia, 1925.

The first volume of this important publication has been completed by the issue of part 8, containing the indexes to the Dutch and English parts and some additions to the text. This volume discusses in a scholarly way the meteorological processes which fashion the weather of the Dutch possessions in the East Indies; it forms an excellent introductory textbook in the meteorology of the equatorial regions. The work is published in Dutch with a full English summary, arranged in such a way that the two parts can be bound separately; this excellent arrangement may be commended to the notice of editors of

other bi-lingual series. Part 3 was reviewed in the *Meteorological Magazine* for December, 1923, and parts 6 and 7 in that for March, 1925, so that a detailed account of the contents is not now required.

We learn from the Preface that Volume II. will deal with the local climate of the different islands, and that the third volume will comprise tables of climatological normals.

A Selection of Botanical and other Papers. By the late Jorge V. Perez, M.B., M.R.C.S. 8vo. $8\frac{1}{2} \times 5\frac{1}{2}$, pp. 53. London, Taylor & Francis. 1925.

This little book is mainly for botanists, but contains a few papers of meteorological interest. One of these describes an experiment on the effect of forests on water-supply.

Dr. Marloth exposed two rain-gauges on the summit of Table Mountain, Cape Colony, which is frequently swathed in mist. One of these gauges was normally exposed, while the other contained about twenty small canes. From December 21st, 1902, to February 15th, 1903, the former gauge registered 125 millimetres, the latter as much as 2 metres. It is recorded that in Madeira large amounts of water were formerly obtained by the agency of a certain tree in the cloud belt, whose leaves condensed the moisture and allowed it to drip into cisterns placed beneath. There is a similar " occult " precipitation in the cloud belt of Teneriffe, and the moral is the importance of afforestation. Another paper describes the method of dry farming in Lanzarote, where only a small amount of rain falls in winter. The fields are covered by a thin layer of pumice, which is very hygroscopic and prevents undue evaporation during the dry summer.

News in Brief

We note with much interest that Mr. H. Johnston, of Downpatrick, Ireland, has been a subscriber to the Daily Weather Reports of the Meteorological Office for the past fifty years, and we are sure that our readers will join in congratulating both Mr. Johnston and ourselves on this record.

The Staff of the Meteorological Office, Edinburgh, assisted by members from Eskdalemuir Observatory and Renfrew Aerodrome held a most successful social gathering in Edinburgh on December 19th. The party met for dinner at Ferguson & Forrester's Restaurant and the remainder of the evening was spent in dancing at the *Palais de Danse.* It is hoped that on future occasions members from other stations in Scotland will be able to be present.

The Weather of December, 1925

THE cold weather experienced during the greater part of November continued generally during the first week of December with many bright periods and severe frost, 13° F. and 12° F. were registered in the screen at Rhayader and Eskdalemuir on the 4th and 6th respectively, and grass minima fell to 7° F. at Rhayader on the 3rd and 4th, and to 6° F. at Cranwell on the 6th. Fog occurred in many places, notably on the 4th, when it persisted throughout the day in London. Snow, sleet and hail fell generally, and snow-lying to a depth of 4 to 5 in. was recorded at Balmoral on the 6th and 7th, and Norwich on the 8th. On the 5th a deep depression was situated north of the Azores and extended its influence slowly east and north. Southerly winds spread over the British Isles and the temperature rose quickly, the highest reading, 56° F., occurred at Valencia on the 6th. The thaw caused extensive floods in north-east Yorkshire. After the 8th the centre of this deep depression moved east across the north of Scotland, and pressure became high on the Atlantic, re-establishing northerly winds and wintry weather over the British Isles. Snow and sleet occurred in most parts, and in a few places the temperature did not rise above freezing point on the 13th, 14th and 15th. By the 17th the winds became westerly and milder weather set in. This, however, only lasted a short while, as a low pressure area centred off our south-west coasts on the 19th, gradually moved along the English Channel and North Sea to Scandinavia, giving easterly winds backing to north-west, with cold weather from that day until the 25th. Rain and snow occurred generally, the depth of snow reported at Lairg, in Sutherland, being 18 in. On the 19th a screen minimum of 9° F. and a grass minimum of 0° F. were registered at Balmoral, and on the 25th the maximum at Eskdalemuir was only 19° F With the approach of a depression from the Atlantic the winds became westerly on the 26th, and there was a rapid rise of temperature. Mild rainy weather continued until the end of the month, with gales and high winds from the 29th to 31st. Gusts of 88 m.p.h. and 85 m.p.h. were reported from Southport and Holyhead on the 30th. The heaviest rainfall occurred on the 28th and 29th, 86 mm. (3·40 in.) falling at Llyn Fawr (Glamorgan) on the 28th, and 70 mm. (2·77 in.) at Holne (Devon) on the 29th. As a result of the rapid thaw and subsequent heavy rains, many parts of the country were flooded. The total rainfall was generally below normal in the western districts and above normal in the eastern, the percentage value being as low as 47 at Ardgillan (Dublin) and as high as 178 at Brighton.

Pressure was above normal over Iceland and the Mediterranean, the excess being 12·2 mb. at Isafjord, and 2·2 mb. at Rome, and below normal in a belt extending from the White Sea and the

Faroës to Spain, the Azores and Newfoundland, the greatest deficits being at Horta (13·4 mb.) and in southern Scandinavia (over 10 mb.). This distribution favoured northerly winds. Temperature was low over north-west Europe (the lowest reading in Sweden being −38° F. at Gällivare on the 16th), but as much as 5° F. above normal at Lisbon, while the rainfall was much above normal over Scandinavia and central Europe, but deficient in north Scotland and Spitsbergen. During the first three weeks of the month severe cold and much snow were experienced over the whole of Europe. In Venice certain portions of the lagoon were frozen over by the 6th, and on the 9th the Danube was rapidly freezing over at Budapest. Frosts were even reported from Seville. Owing to the exceptionally severe weather wolves have attacked several villages in northern Italy and central Europe. Between the 21st and 23rd severe gales, accompanied by a rapid rise of temperature, swept across France and Switzerland, causing considerable damage. Violent thunderstorms occurred on the 21st and 22nd along the Jura. By the 23rd much of the snow had disappeared from the lower lying parts of Europe, and heavy rains persisted from then to the 31st. These, in conjunction with the thaw, caused extensive floods in central Europe, Holland, Belgium and France.

At the beginning of the month severe storms were reported from America and the North Atlantic. After a week of mild weather before Christmas, a severe gale swept across New York State from the Middle West on the 24th and 25th, and the temperature fell rapidly.

The rainfall of Australia was generally somewhat below normal, the greatest deficits, about 120 mm. (4·7 in.), occurring on the north coast of Queensland. In southeast Queensland, however, it was slightly below normal.

Owing to the collapse of a sand embankment, due to the heavy rain, a passenger train on the Mayavaram-Avanthangi branch of the South Indian railway was overturned and nine people are reported to have been killed.

The special message from Brazil states that the rainfall in the northern districts was irregular, average 4 mm. above normal, but plentiful in the central and southern districts where the totals were 41 mm. and 31 mm. above normal respectively. More anticyclones of moderate intensity passed across the country than in the previous month. The crops generally were doing well. At Rio de Janeiro pressure was 0·3 mb. above normal and temperature 1·8° F. above normal.

Rainfall, 1925—General Distribution

	Dec.	Year	
England and Wales	103	108	per cent. of the average 1881-1915.
Scotland	89	101	
Ireland	76	98	
British Isles	94	104	

Rainfall: December, 1925: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square.....	2·79	71	117	*War.*	Birmingham, Edgbaston	2·44	62	91
Sur.	Reigate, Hartswood...	3·25	83	108	*Leics*	Thornton Reservoir ..	2·44	62	91
Kent.	Tenterden, Ashenden..	4·29	109	137	,, .	Belvoir Castle.....	1·85	47	75
,, .	Folkestone, Boro. San.	3·85	98	...	*Rut.*	Ridlington.....	2·10	53	...
,, .	Broadstairs, St Peter's	2·24	57	94	*Linc.*	Boston, Skirbeck	1·78	45	83
,, .	Sevenoaks, Speldhurst.	3·99	101	...	,, .	Lincoln, Sessions House	1·35	34	62
Sus.	Patching Farm.....	4·93	125	147	,, .	Skegness, Estate Office.	...	..	...
,, .	Brighton, Old Steyne .	5·53	141	178	,, .	Louth, Westgate	1·82	46	65
,, .	Tottingworth Park....	5·22	133	141	,, .	Brigg	2·09	53	86
Hants	Ventnor, Roy. Nat. Hos.	4·85	123	147	*Notts.*	Worksop, Hodsock....	1·96	50	83
,, .	Fordingbridge, Oaklnds	...	..	...	*Derby*	Mickleover, Clyde Ho..	2·32	59	88
,, .	Ovington Rectory	4·22	107	106	,, .	Buxton, Devon. Hos...	3·40	86	60
,, .	Sherborne St. John Rec.	3·82	97	116	*Ches.*	Runcorn, Weston Pt...	2·41	61	77
Berks	Wellington College...	3·11	79	108	,, ..	Nantwich, Dorfold Hall	2·49	63	...
,, .	Newbury, Greenham..	3·22	82	101	*Lancs*	Manchester, Whit. Pk.	2·36	60	73
Herts.	Benington House	2·20	56	89	,, ..	Stonyhurst College....	4·41	112	91
Bucks	High Wycombe	2·61	66	89	,, ..	Southport, Hesketh...	2·26	57	70
Oxf. .	Oxford, Mag. College..	2·08	53	90	,, ..	Lancaster, Strathspey.	...	..	...
Nor.	Pitsford, Sedgebrook..	...	..	...	*Yorks*	Sedbergh, Akay	6·21	158	105
,, .	Eye, Northolm.....	1·79	45	...	,, .	Wath-upon-Dearne ...	2·37	60	100
Beds.	Woburn, Crawley Mill.	1·90	48	81	,, .	Bradford, Lister Pk...	5·16	131	154
Cam.	Cambridge, Bot. Gdns.	1·54	39	80	,, .	Wetherby, Ribston H..	2·68	68	109
Essex	Chelmsford, County Lab	2·14	54	96	,, .	Hull, Pearson Park ...	3·13	79	130
,, .	Lexden, Hill House...	1·88	48	...	,, .	Holme-on-Spalding ...	2·65	67	...
Suff.	Hawkedon Rectory ...	1·86	47	77	,, .	West Witton, Ivy Ho..	5·37	136	...
,, .	Haughley House.....	1·45	37	...	,, .	Felixkirk, Mt. St. John	3·04	77	126
Norf.	Beccles, Geldeston....	2·21	56	96	,, .	Pickering, Hungate ...	4·09	104	...
,, .	Norwich, Eaton	2·53	64	97	,, .	Scarborough.....	4·83	123	203
,, .	Blakeney	3·27	83	147	,, .	Middlesbrough	2·76	70	142
,, .	Swaffham	2·15	55	90	,, .	Baldersdale, Hury Res.	...	..	...
Wilts.	Devizes, Highclere....	3·29	84	107	*Durh.*	Ushaw College	3·75	95	150
,, .	Bishops Cannings	3·04	7	93	*Nor.*	Newcastle, Town Moor.	4·60	117	191
Dor.	Evershot, Melbury Ho.	...	..	...	,, .	Bellingham, Highgreen	5·07	129	...
,, .	Weymouth, Westham..	...	..	...	,, .	Lilburn Tower Gdns...	4·82	122	...
,, .	Shaftesbury, Abbey Ho.	3·47	88	96	*Cumb*	Geltsdale.....	3·49	89	...
Devon	Plymouth, The Hoe...	5·31	135	106	,, .	Carlisle, Scaleby Hall .	3·30	84	103
,, .	Polapit Tamar	5·48	139	107	,, .	Seathwaite M.....	12·66	320	78
,, .	Ashburton, Druid Ho..	8·70	221	116	*Glam.*	Cardiff, Ely P. Stn.....	4·13	105	81
,, .	Cullompton	3·99	101	91	,, .	Treherbert, Tynywaun	9·68	246	...
,, .	Sidmouth, Sidmount ..	4·68	119	119	*Carm*	Carmarthen Friary....	4·54	115	79
,, .	Filleigh, Castle Hill ...	4·23	107	...	,, .	Llanwrda, Dolaucothy.	6·94	176	99
,, .	Barnstaple, N. Dev. Ath.	...	..	...	*Pemb*	Haverfordwest, School	4·30	109	75
Corn.	Redruth, Trewirgie ...	5·88	149	94	*Card.*	Gogerddan.....	4·00	102	79
,, .	Penzance, Morrab Gdn.	4·81	122	85	,, .	Cardigan, County Sch. .	3·79	96	...
,, .	St. Austell, Trevarna..	7·22	183	118	*Brec.*	Crickhowell, Talymaes	4·10	104	...
Soms	Chewton Mendip	5·35	136	99	*Rad.*	Birm. W. W. Tyrmynydd	6·43	163	78
,, .	Street, Hind Hayes ...	2·63	67	...	*Mont.*	Lake Vyrnwy	8·43	214	122
Glos. .	Clifton College	5·29	134	138	*Denb.*	Llangynhafal	3·77	96	...
,, .	Rendcomb College ...	3·50	89	102	*Mer.*	Dolgelly, Bryntirion ..	5·08	129	74
Here.	Ross, Birchlea.....	3·19	81	107	*Carn.*	Llandudno	2·56	65	83
,, .	Ledbury, Underdown.	3·25	83	116	,, .	Snowdon, L. Llydaw 9	15·07	383	...
Salop	Church Stretton.....	3·27	83	97	*Ang.*	Holyhead, Salt Island.	3·11	79	75
,, .	Shifnal, Hatton Grange	2·48	63	97	,, .	Lligwy	2·72	69	...
Staff.	Tean, The Heath Ho...	2·68	68	82	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	2·40	61	92		Douglas, Boro' Cem...	4·29	109	87
,, .	Blockley, Upton Wold.	2·54	65	78	*Guernsey*				
War.	Farnborough.....	1·79	15	61		St. Peter P't, Grange Rd	6·34	161	155

Rainfall: December, 1925: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	4·08	104	100	*Suth.*	Loch More, Achfary...	9·02	229	98
,, .	Pt. William, Monreith .	4·57	116	...	*Caith*	Wick	2·59	66	84
Kirk.	Carsphairn, Shiel.	8·48	215	...	*Ork .*	Pomona, Deerness	2·49	63	59
,, .	Dumfries, Cargen.....	4·47	113	83	*Shet .*	Lerwick	4·04	103	84
Dum	Drumlanrig	...	..	...					
Roxb	Branxholme	4·20	107	125	*Cork.*	Caheragh Rectory	5·70	145	...
Selk .	Ettrick Manse.....	5·72	145	...	,, ..	Dunmanway Rectory.	6·28	159	77
Berk.	Marchmont House	3·99	101	142	,, ..	Ballinacurra	3·23	82	63
Hadd	North Berwick Res....	2·42	61	112	,, ..	Glanmire, Lota Lo. ...	3·99	101	72
Midl	Edinburgh, Roy. Obs..	3·35	85	157	*Kerry*	Valencia Obsy.	4·23	107	64
Lan .	Biggar	3·22	82	95	,, .	Gearahameen	11·00	279	...
Ayr .	Kilmarnock, Agric. C..	3·66	93	86	,, .	Killarney Asylum.....	5·07	129	70
,, .	Girvan, Pinmore.....	4·56	116	76	,, .	Darrynane Abbey	4·15	105	71
Renf.	Glasgow, Queen's Pk..	3·07	78	73	*Wat .*	Waterford, Brook Lo..	2·82	72	61
,, .	Greenock, Prospect H..	4·04	103	51	*Tip .*	Nenagh, Cas. Lough...	3·51	89	76
Bute.	Rothesay, Ardencraig.	3·71	94	68	,, .	Tipperary	3·67	93	...
,, .	Dougarie Lodge	2·96	75	...	,, .	Cashel, Ballinamona ..	2·94	75	68
Arg .	Ardgour House	9·09	231	...	*Lim .*	Foynes, Coolnanes	3·42	87	72
,, .	Manse of Glenorchy..	7·54	191	...	,, .	Castleconnell Rec.	2·70	69	...
,, .	Oban	3·98	101	...	*Clare*	Inagh, Mount Callan ..	4·80	122	...
,, .	Poltalloch	3·97	101	62	,, .	Broadford, Hurdlest'n.	3·56	90	...
,, .	Inveraray Castle.....	6·00	152	60	*Wexf*	Newtownbarry	3·13	79	...
,, .	Islay, Eallabus.....	4·32	110	73	,, .	Gorey, Courtown Ho...	2·73	69	71
,, .	Mull, Benmore	8·00	203	...	*Kilk.*	Kilkenny Castle	2·28	58	66
Kinr.	Loch Leven Sluice	2·47	63	63	*Wic .*	Rathnew, Clonmannon	2·45	62	...
Perth	Loch Dhu	6·25	159	61	*Carl.*	Hacketstown Rectory .	2·55	65	62
,, ..	Balquhidder, Stronvar.	5·06	129	53	*QCo..*	Blandsfort House.....	...	..	...
,, ..	Crieff, Strathearn Hyd.	4·30	109	96	,,	Mountmellick	2·89	73	...
,, ..	Blair Castle Gardens ..	3·59	91	94	*KCo.*	Birr Castle.....	1·70	43	52
,, .	Coupar Angus School..	3·10	79	103	*Dubl.*	Dublin, FitzWm. Sq...	1·81	46	73
Forf.	Dundee, E. Necropolis.	2·57	65	97	,, .	Balbriggan, Ardgillan .	1·37	35	47
,, .	Pearsie House.....	2·46	63	...	*Me'th*	Drogheda, Mornington	1·36	35	...
,, .	Montrose, Sunnyside..	1·60	41	58	,, .	Kells, Headfort.....	2·55	65	67
Aber.	Braemar, Bank	4·57	116	128	*W.M*	Mullingar, Belvedere .	2·52	64	68
,, .	Logie Coldstone Sch. ..	3·86	98	137	*Long*	Castle Forbes Gdns....	2·46	63	62
,, .	Aberdeen, King's Coll..	1·81	46	56	*Gal .*	Ballynahinch Castle ..	...	..	...
,, .	Fyvie Castle	4·46	113	...	*Mayo*	Mallaranny.....	5·84	148	...
Mor .	Gordon Castle.....	2·39	61	89	,, .	Westport House.....	3·76	95	65
,,	Grantown-on-Spey....	2·30	58	85	,, .	Delphi Lodge	5·88	149	...
Na .	Nairn, Delnies.....	1·85	47	83	*Sligo*	Markree Obsy.	3·66	93	77
Inv..	Ben Alder Lodge	7·45	189	...	*Cav'n*	Belturbet, Cloverhill..	2·28	58	78
,, .	Kingussie, The Birches	3·60	91	...	*Ferm*	Enniskillen, Portora ..	...	..	...
,, .	Loch Quoich, Loan....	14·10	358	...	*Arm.*	Armagh Obsy.	2·51	64	80
,, .	Glenquoich	...	..	...	*Down*	Warrenpoint	2·46	63	...
,, .	Inverness, Culduthel R.	2·54	65	...	,, .	Seaforde	3·55	90	86
,, .	Arisaig, Faire-na-Squir	4·14	105	...	,, .	Donaghadee, C. Stn...	3·19	81	100
,, .	Fort William.....	8·52	216	85	,, .	Banbridge, Milltown .	2·65	67	95
,, .	Skye, Dunvegan.....	7·21	183	...	*Antr.*	Belfast, Cavehill Rd. .	4·11	104	...
,, .	Barra, Castlebay	2·59	66	...	,, .	Glenarm Castle.....	4·56	116	...
R&C	Alness, Ardross Cas. ..	4·74	120	115	,, .	Ballymena, Harryville	4·10	104	92
,, .	Ullapool.....	6·32	160	...	*Lon .*	Londonderry, Creggan	5·08	129	116
,, .	Torridon, Bendamph..	9·53	242	95	*Tyr .*	Donaghmore	4·13	105	...
,, .	Achnashellach	9·98	253	...	,, .	Omagh, Edenfel	3·60	91	85
,, .	Stornoway	5·74	146	92	*Don .*	Malin Head	4·07	103	121
Suth.	Lairg	4·46	113	...	,, .	Rathmullen.....	5·47	139	...
,, .	Tongue Manse.....	4·54	115	92	,, .	Dunfanaghy	5·51	140	108
,, .	Melvich School.....	4·66	118	108	,, .	Killybegs, Rockmount.	5·51	140	76

Climatological Table for the British Empire, July, 1925

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1013·7	— 2·1	87	49	73·4	55·6	64·5	+ 1·8	57·4	84	6·5	100	+ 45	13	6·0	38
Gibraltar	1016·6	— 0·2	87	60	78·7	64·4	71·5	— 3·3	62·8	78	5·4	5	+ 4	1	...	...
Malta	1015·6	+ 0·3	92	65	83·2	70·8	77·0	— 1·3	70·6	74	2·1	0	— 1	0	11·3	79
Sierra Leone	1013·9	+ 0·5	88	67	82·6	71·7	77·1	— 1·9	74·8	86	7·6	780	— 96	28	...	...
Lagos, Nigeria	1011·7	— 2·1	87	70	84·6	73·6	79·1	+ 1·8	75·2	83	7·8	387	+118	15	...	...
Kaduna, Nigeria	1014·2	+ 0·2	90	...	84·0	...	...	...	68·9	81	2·4	386	+178	19	...	...
Zomba, Nyasaland	1018·8	+ 0·3	79	46	71·6	53·0	62·3	+ 0·4	...	82	6·7	14	+ 6	5	...	...
Salisbury, Rhodesia	1020·3	— 0·5	77	36	69·3	43·3	56·3	+ 0·2	49·7	61	2·2	2	+ 1	3	8·6	77
Cape Town	1022·0	+ 1·2	77	39	62·3	49·1	55·7	+ 1·0	50·3	83	5·3	102	+ 6	15	...	...
Johannesburg	1025·5	+ 0·3	69	30	59·9	38·5	49·2	— 1·4	39·5	61	2·0	5	— 1	2	8·9	84
Mauritius	1020·6	+ 0·2	78	58	75·9	62·2	69·1	+ 0·8	71·1	73	5·4	61	— 2	23	6·9	63
Bloemfontein	...	...	71	19	60·8	31·2	46·0	— 1·3	36·8	73	3·2	1	— 9	1	...	...
Calcutta, Alipore Obsy.	999·3	+ 0·1	93	76	87·7	78·8	83·3	— 0·2	78·8	89	9·2	451	+133	22*	...	...
Bombay	1005·2	+ 1·3	88	77	85·8	78·6	82·2	+ 0·9	77·3	82	8·1	213	−403	16*	...	...
Madras	1005·8	+ 1·3	104	72	96·3	79·2	87·7	+ 0·3	75·2	60	7·0	97	— 3	6*	...	...
Colombo, Ceylon	1010·1	+ 0·9	87	71	85·8	76·7	81·3	+ 0·2	77·7	75	8·3	146	— 18	13	7·0	56
Hong Kong	1004·2	— 0·6	92	74	87·8	78·3	83·1	+ 0·6	78·5	75	6·7	525	+185	17	8·7	65
Sandakan	...	...	91	72	87·1	74·9	81·0	— 0·9	75·5	81	...	208	+ 42	15	...	...
Sydney	1015·5	— 2·9	69	41	62·0	45·1	53·5	+ 1·0	46·6	74	3·5	6	—120	6	6·8	67
Melbourne	1016·9	— 2·2	61	31	54·1	42·3	48·2	— 0·4	44·3	84	7·8	59	+ 13	21	2·6	26
Adelaide	1019·3	— 1·1	67	38	59·2	45·8	52·5	+ 0·9	47·7	79	8·1	54	— 13	22	4·0	40
Perth, W. Australia	1021·8	+ 2·8	69	37	62·1	45·1	53·6	— 1·6	48·8	75	4·9	175	+ 9	16	5·9	58
Coolgardie	1022·4	+ 2·5	72	32	60·5	38·8	49·7	— 1·5	43·3	67	2·6	7	— 16	4	...	...
Brisbane	1017·9	— 0·5	75	37	67·2	46·4	56·8	— 1·7	49·2	68	2·9	18	— 41	4	8·3	79
Hobart, Tasmania	1012·9	— 0·9	60	31	51·2	39·3	45·3	— 0·1	40·6	82	7·7	78	+ 24	15	4·3	46
Wellington, N.Z.	1012·8	— 0·1	61	32	53·4	43·9	48·7	+ 1·0	46·1	83	7·3	111	— 35	19	3·2	34
Suva, Fiji	1013·0	— 1·2	86	60	77·3	65·5	71·4	— 2·2	68·0	81	6·1	177	+ 60	15	...	...
Apia, Samoa	1012·9	+ 0·9	87	67	83·7	72·5	78·1	+ 0·9	74·1	74	4·4	36	— 31	9	7·8	68
Kingston, Jamaica	1014·9	+ 0·2	92	70	90·0	72·6	81·3	— 0·4	71·5	79	3·5	14	— 28	2	...	...
Grenada, W.I.	1014·8	+ 1·5	88	72	84·4	74·3	79·3	+ 0·4	75·6	81	6·6	192	— 57	27	...	...
Toronto	1013·0	— 1·1	88	46	77·0	58·0	67·5	— 0·7	60·2	69	4·6	89	+ 12	10	8·7	58
Winnipeg	1014·3	+ 1·6	93	45	78·3	54·9	66·6	+ 0·4	58·1	80	3·7	15	— 62	9	9·5	60
St. John, N.B.	1012·4	— 1·3	78	45	68·2	52·8	60·5	+ 0·1	56·4	84	7·0	85	— 7	16	5·6	37
Victoria, B.C.	1018·2	+ 1·5	75	49	67·7	49·0	58·3	— 2·0	55·0	76	3·0	4	— 5	2	12·5	80

*For Indian sta[illegible] rain day is a day on [illegible] 0·1 in. (2·5 mm.) or more rain has fallen.